RELATIVE PERFORMANCE OF SOYBEAN GENOTYPES SELECTED FOR DIVERSE SHORT-DAY ENVIRONMENTS

BY

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To my wife, Dora Elia

and

sons

Gerardo and Fernando

with love and gratitude

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Soybean [*Glycine max* (L.) Merrill] cultivars adapted to temperate regions usually perform poorly in tropical environments. The shorter photoperiods cause reduced growth, early maturity, and low yield. However, later maturing cultivars have good yield potentials in tropical environments. The soybean breeding program at Gainesville, Florida, contained late maturing genotypes potentially well adapted to tropical environments and to mid-July planting in southern U.S. The purpose of this study was to determine the extent to which selection among late maturing genotypes at Gainesville (29° 30' N-latitude) influences performance at Tancasneque, Tamaulipas, Mexico (22° 13' N-latitude), and to identify developmental characteristics which could be selected at Gainesville to improve performance at lower latitudes.

Breeding stocks selected were in two developmental stages. For Experiment 1, seeds from 621 individual plants selected in 1977 produced progeny rows at both Gainesville and Tancasneque in 1978. Breeding lines established from rows at each location were evaluated in replicated plots in 1979 and 1980. For Experiment 2, 42 lines which had survived preliminary yield tests at Gainesville were selected and evaluated similarly in 1979-1980. Selected lines were near the height and maturity of Jupiter, a cultivar well adapted to tropical environments and to late plantings at Gainesville. Evaluation locations were expanded to include Boliche, Ecuador (2° 15' S-latitude), in 1979 and 1980, and Tapachula, Chiapas, Mexico, in 1980 (14° 59' N-latitude).

Growth characteristics of nearly all selected lines were acceptable for cultivars in all tropical environments. Seed yields in tropical environments often equalled or exceeded seed yields in mid-July plantings at Gainesville. In nearly all environments genotypes in both experiments differed significantly in yield.

In Experiment 1, few genotype X environment interactions were significant. These results and comparisons of yield means indicated that selection for yield at Gainesville would tend to improve the yield potential for tropical environments. Significant positive correlations between seed yield at Tancasneque and plant height and maturity at Gainesville indicate that selecting the taller, later

maturing plant types at Gainesville would further improve the yield potential for tropical environments.

In Experiment 2, nearly all genotype X environment interactions were significant. These significant interactions included genotype X year interactions at Tancasneque and Boliche, but not at Gainesville. Results from Experiment 2 indicate generally poor agreement among environments in relative yield. The Gainesville environments tended to be among the best predictors of overall yield. However, examination of yield means show that very rigid selection for yield at Gainesville would have eliminated one genotype which yielded very well in nearly all tropical environments.

The overall results indicate that selection at Gainesville for plant types adapted to tropical environments can be very effective, that modest selection for yield will likely be beneficial, but that rigid selection for yield should be avoided.

INTRODUCTION

Yield potential of soybean [*Glycine max* (L.) Merrill] in tropical areas is similar to that in temperate regions (Whigham et al., 1978). However, cultivars adapted to temperate regions usually give unsatisfactory results in tropical regions. Plants flower within 25 to 30 days after emergence, mature when they are less than 100 days old, and produce poor quality seed. The early flowering results in short plants with seed produced too close to the ground for efficient mechanical harvesting. In southern U.S., adapted determinate cultivars usually flower in 45 to 60 days after emergence. When conditions such as warm, moist soil and high air temperature favor rapid early season growth, the shorter part of the time-to-flower range usually is best. Theoretically, a similar time is also best for the tropics. Only cultivars in maturity groups IX and X flower late enough in the tropics to be considered well adapted.

The U.S.D.A. (United States Department of Agriculture) germplasm collections contain more than 200 entries in maturity groups IX and X. Many of these entries have been evaluated at several tropical locations. They proved to be generally low yielding and to have poor agronomic characteristics. However, among the group evaluated near Veracruz, Mexico during the early 1960's, one was released and named "Tropicana."

Production of Tropicana increased to about 62,000 hectares by 1974 in the Tampico, Tamaulipas, Mexico, area.

"Jupiter" was released in 1972. Studies at Huastecas Experimental station near Tampico demonstrated that Jupiter yielded about 50% more than Tropicana, held its seeds much better, and possessed other more desirable characteristics. Jupiter soon replaced Tropicana in the Tampico area of Mexico and by 1977 was grown on about 95,000 hectares. More recently, Jupiter production has been initiated near Tapachula, Chiapas, Mexico (14° 59' N-latitude).

These results demonstrate the dramatic effect improved cultivars can have on tropical soybean production. They also suggest the need for breeding programs in areas of intended production. During the last decade, new programs have been started. However, progress may be slow because some time will be required to train personnel, accumulate germplasm, and adapt physical facilities.

Jupiter was developed in the breeding program at Gainesville, Florida. The success of Jupiter in tropical areas demonstrated that work at Gainesville can be applicable to these regions. Beginning in 1970, a part of the Gainesville program was directed toward developing soybean genotypes potentially well adapted to tropical regions or to late plantings in souther U.S. These materials were used in the thesis study reported here.

The purpose of this study was to determine the effect of selection at Gainesvill on performance in Mexico and to

identify specific traits or developmental characteristics which could be selected at Gainesville to improve performance at lower latitudes.

LITERATURE REVIEW

Research conducted on soybean in tropical environments has focused primarily on testing existing cultivars and on cultural practices. Results are available which show that soybean can produce acceptable yields in the tropics (Whigham, 1975; Whigham, 1976; Whigham et al., 1978).

Kretschmer (1967) stated that the tropics can be defined as that area enclosed by the Tropic of Capricorn and the Tropic of Cancer, respectively, latitudes 23° 27' south and 23° 27' north of the equator. The tropics can be characterized generally as having ill-defined seasons with little change in daylength. Rainfall occurs throughout the year in some areas; some other areas are characterized by distinct wet and dry seasons, whereas still other areas have little rainfall. Compared with temperate regions, the tropics have short day length with relatively little variation throughout the year.

Since length of day is governed by latitude, soybean varieties are adapted to rather narrow belts running east and west in the United States. For convenience, varieties have been divided into 12 maturity groups: 00, 0, I, etc., through X. Lower numbered groups are adapted to northern latitudes, and the higher numbered groups are adapted progressively further south. With long days, soybean plants continue to make vegetative growth and under field conditions

do not produce flowers until the period of daylight has shortened below a critical level. This critical level is specific for each cultivar but is influenced by the age of the plants when day length is near the critical level. Short days reduce the time from flowering to maturity as well as the time from emergence to flowering (Hinson & Smith, 1967).

Cultivars classed in group VIII are the latest grown in continental U.S. In general, cultivars adapted to continental U.S. flower too early to make adequate growth for producing satisfactory seed yields when planted in short-day regions of the world (Hartwig, 1973).

Hartwig (1970) stated that a 45-day period from emergence to early bloom approaches the minimum to permit plants to make adequate growth for producing moderate seed yields and to have pods high enough from the ground to permit machine harvesting without excessive losses.

Introductions are available that will flower later than group VIII cultivars when grown in low latitude regions (Hartwig, 1970). These are presently identified as groups IX and X. Many of these make adequate growth under short-day conditions, but nearly all are indeterminate and have poor agronomic qualities. Jupiter, developed at Gainesville, Florida, has a determinate growth habit and makes good growth under short-day conditions (Hartwig, 1973). The good performance of Jupiter under short-day conditions has been confirmed by Perez and Tijerina (1976) and Judy and Hill (1979). Jupiter is maturity group IX (Hinson, 1972).

In 1958, the soybean crop was introduced into the northwest of Mexico (27° to 28° N-latitude). When production began, farmers relied heavily on the cultivars commercially grown in the United States such as Lee, Hood, Hill, and later Dare, Davis, Bragg. These varieties are in maturity groups V to VII. When these cultivars were evaluated 14° to 22° N-latitude, they showed poor growth, low pod set and obviously low yields (Crispin, 1975).[1] The poor performance of these maturity group V through VII cultivars at 14° and 22° was associated with their early flowering. Other studies demonstrating that early-maturing cultivars are poorly adapted to low latitude environments include Barrios (1961); Barrios and Ortega (1968); Camacho et al. (1974); Basnet et al. (1974); and Beard et al. (1980).

In 1973 and 1974, the material provided by INTSOY was studied at Tampico, Tamaulipas, Mexico (22° 13' N-latitude) and the Jupiter cultivar (included in the INTSOY trails) was more promising than Tropicana, the cultivar being grown by farmers in the Tampico area. In 1975, farmers near Tampico began to replace Tropicana with Jupiter and by 1979 were only growing Jupiter (De la Paz et al., 1979). More recently, Jupiter production has been initiated near Tapachula, Chiapas, Mexico (14° 59' N-latitude).

Although cultivars ranging in latitude adaptation from 50° to 0° are available, soybean breeding programs have not

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[1]Paper circulated to soybean researchers in Mexico. Crispin, M.A. 1975. The search for soybean varieties for the tropical lowlands of Mexico.

yet met cultivar needs for many tropical areas (Hinson & Hartwig, 1977). Tropical environments are highly variable not only from one location to another, but also from year to year at a particular location.

Crispin (1975) listed five problems commonly found with the soybean crop in tropical areas of Mexico:

1. Excess rainfall hinders cultivation and enhances fungal and bacterial diseases.

2. Cloud cover is highly variable and unpredictable. This causes inconsistent performance and unreliable experimental results.

3. High relative humidity when plants mature is common. This causes seeds to germinate in pods of some cultivars.

4. Abnormally long rainy periods causes nonuniform maturity. Some plants renew vegetative growth even when pods have already matured.

5. Severe chlorosis is commonly observed even when micronutrients are used and seeds are inoculated.

Another problem common to soybean in the tropics was discussed in the 1980 INTSOY Newsletter (anonymous, 1980). Producers have difficulty obtaining good quality seed for planting. All soybean seeds are capable of carrying many kinds of microorganisms and viruses. Seedborne microorganisms include various fungi (molds) and bacteria, many of which can cause disease in soybean plants. Some of the important effects of these microorganisms are reductions in storage life, germination, emergence, vigor, and eventually yields. The writer related the disease situation to storage

life of the soybean under tropical conditions in Puerto Rico and concluded that soybean fields used for producing seeds should be located in areas where dry conditions prevail during maturation of the seeds. Basnet et al. (1974) reached the same conclusion from a two-year study in Sikkim (Hilalayan Kingdom). The later maturing cultivar which matured during favorable harvest weather produced good seed quality. Earlier maturing cultivars did not.

Although soybean can be grown during the entire year under tropical conditions or short-day environments, the above findings suggest that planting dates must be selected in order for the plants to reach maturity during dry weather conditions.

The existence of extreme environmental variation emphasizes that data obtained in any one year or at any one site cannot be considered as an adequate basis for varietal recommendation. Thus, a measure of the relative stability of cultivars under a wide range of environmental conditions becomes necessary in determining efficient breeding procedures. Information obtained from estimates of the various cultivar X environment interactions are useful in an efficient variety evaluation program (Liang et al., 1966).

Genotype-environment interactions have been of concern to plant breeders for many years (Eberhart & Russell, 1966). The presence of genotype-environment interactions complicate evaluation procedures and reduce the efficiency of genetic advance through selection (Comstock & Moll, 1963). The cause of genotype-environment interactions is not always known.

Oka (1975) stated that when a number of soybean cultivars are tested at different locations or in different years, a large genotype-environment interaction masking genotypic variation is often observed even though no marked difference could be detected among the environments.

From 1954 through 1956, entries in Uniform Regional soybean trials of several maturity groups, including VI and VII, remained unchanged for three years. Data collected have been studied in various ways. Schutz and Bernard (1967) suggested that locations may be effectively substituted for years in regional tests to permit a rapid turnover of breeding material. Brim (1973) stated that further analyses indicated a distinct potential for developing cultivars with specific adaptation to subregions within the area sampled by maturity groups VI and VII tests.

Frey and Maldonado (1967) suggested that the following five factors may contribute to cultivar X location interactions in oats within Iowa: (a) soil fertility, (b) moisture supply, (c) density of stand, (d) pests, and (e) temperature fluctuations. All of these factors may be even more important in contributing to cultivar X location interactions in soybean tests conducted at Gainesville, Florida and Tampico, Mexico. Soil properties are distinctly different at the two locations. The Gainesville soil is sandy, slightly acid, high in P, moderately low in K, whereas the Tampico soil is clay, alkaline (pH nearly 8.0), low in P, and high in K. These factors suggest that the probability of effectively

selecting soybean genotypes at Gainesville for performance at Mexico may be low. However, Jupiter was selected at Gainesville and it performs very well in Mexico. Further, Baihaki et al. (1976) concluded that despite cultivar X environment interactions in soybean, superior cultivars can be identified from single environment preliminary yield tests.

Experimental evidence in soybean has shown that flowering date, plant height, harvesting date, resistance to disease, lodging, and shattering are characters with high heritability, but yield is a character with low heritability. Hanson et al. (1962) indicated that, unless a soybean breeder is dealing with a cross which gives an extreme range of progenies, visual discrimination should be used primarily to discard the poor-yielding cultivars. Byth et al. (1969b) suggested that a visual estimation of canopy shape during pod development may be of value in discriminating high-yielding cultivars in advanced generation soybean populations, and that the utility of this selection procedure may be relatively constant across environments. Kwon and Torrie (1964) indicated that the expected gain for yield using visual selection on a single plot basis was approximately 50% as efficient as selection based on plot yield. This and the low heritability of seed yield suggests that a breeder may be better off to advance lines in early generations based upon performance for traits other than yield. Byth et al. (1969a) indicated that actual advance

evaluated over environments may be the only accurate criterion for comparison of selection procedures in the presence of substantial cultivar X environment interactions.

Teixeira (1977) found significant cultivar X planting date interaction at Gainesville. He attributed the interactions to large differences in plant growth associated with maturity class and planting date. Because plants in his late planting made about the same amount of growth that the same cultivars normally make in tropical environments, he suggested that it is likely that selection at Gainesville, on the basis of performance in mid-July planting, may be effective selection for performance at low latitudes.

MATERIALS AND METHODS

Since this research includes two types of experiments, the materials and methods are presented in two parts.

Experiment 1

Six hundred twenty-one individual plants were selected from mid-July plantings at Gainesville, Florida [USA] in 1977. Plants were selected for adaptation to late (mid-July) plantings at Gainesville. Potential adaptation to lower-latitude environments was also considered. Enough seed was harvested from each plant to produce two plant progeny rows. Rows were planted at two locations in 1978: Gainesville (planted July 19) and Tancasneque, Tamaulipas [Mexico] (planted July 25). At each location, row numbers started with 1001 and a Jupiter check was included every 50th row beginning with row number 1013. "UFV-1" served as an additional check in every 50th row beginning with row number 1038.

From these plant rows grown in 1978, 38 plant rows which appeared to have good adaptation to Tancasneque, were selected at Tancasneque. Similarly, the 38 rows which appeared to have good potential for late planting at Gainesville, were selected at Gainesville. Table 1 gives the progenitors, generation, number of lines grown from each

Table 1. Progenitors, generation, number of lines grown and selected at two locations: Gainesville, Florida (USA), and Tancasneque, Tamaulipas (Mexico), in 1978.

Number	Cross parentage	Generation	Row number+	Number of rows	Checks	Number of rows selected at G‡	Number of rows selected at T‡
1	Jupiter X F66-1534	F_6	1001 to 1130	125	5	5	5
2	Jupiter X F67-1533	F_6	1131 to 1216	82	4	7	5
3	Jupiter X F65-170	F_6	1217 to 1278	60	2	10	4
4	Hill X PI 274,454	F_6	1279 to 1329	49	2	2	3
5	UFV-1 X F72-5509	F_6	1130 to 1374	43	2	2	3
6	F72-5514 X (Jupiter X F66-1534)	F_5	1375 to 1405	30	1	2	2

Table 1—continued

Number	Cross parentage	Generation	Row number[+]	Number of rows	Checks	Number of rows selected at G[‡]	Number of rows selected at T[‡]
7	F72-5514 X (Jupiter X F67-1533)	F_5	1406 to 1433	27	1	3	2
8	D73-7894 X [D72-7842 X (Jupiter X F65-170)]	F_4	1434 to 1460	26	1	1	2
9	D73-7894 X [D72-7842 X (Hill X PI 274,454)]	F_4	1461 to 1558	94	4	3	7
10	D73-7894 X [D72-7842 X (Hardee X (Bragg X PI 274,454))]	F_4	1559 to 1647	85	7	3	5
TOTAL				621	29	38	38

[+] 1978 row numbers harvested become F78-line numbers.

[‡] G and T refer to Gainesville and Tancasneque, respectively.

cross, and the number of lines selected from each cross at each location.

In selecting the final 38 rows at each location, two points were considered: (1) having the number of rows selected from each cross proportional to the number of rows grown, and (2) including the very best appearing rows at each location. For example, rows from cross 3 appeared to be especially well adapted at Gainesville, but less well adapted in Tancasneque. Therefore, we selected 10 and four rows from cross 3 at Gainesville and Tancasneque, respectively.

1979 Evaluations

To reduce soil variability within tests, the 76 selected lines were divided into two groups of 38 each with Jupiter and UFV-1 as checks to make 40 entries per test. Since there will be some advantages to having all selections from a particular cross in one test, the arrangement given in Table 2 was made.

Seed supplies in Gainesville for some selected lines were adequate for planting only 12 rows with 200 seeds per row; therefore, the reasoning used was that near maximum information would come from planting these 76 lines at three locations with each location having two replications of two-row plots. The locations were: Gainesville (29° 30' N-latitude), Tancasneque (22° 13' N-latitude), and Tapachula, Chiapas (Mexico), (14° 59' N-latitude).

Table 2. Arrangement of the lines selected in 1978 by cross and test for 1979 evaluation.

Test 1979, A-1			Test 1979, A-2		
	Number of lines selected			Number of lines selected	
Cross[+]	Gainesville	Tancasneque	Cross[+]	Gainesville	Tancasneque
1	5	5	3	10	4
2	7	5	4	2	3
7	3	2	5	2	3
8	1	2	6	2	2
10	3	5	9	3	7
TOTAL	19	19		19	19

[+] See Table 1 for parents in each cross.

Table 3 gives dates of planting, number of entries, number of replications, rows per plot, row length, row width, area harvested for each test, and locations.

Characters measured on a plot basis were:

Number of days from planting to:

Beginning flower—50% of plants produced at least one open flower

Maturity—90% dry pods

Plant height—stem length at maturity (centimeters)

Weight/100 seeds—sample by replication (grams)

Total nodes at maturity—1980 only.

1980 Evaluation

From each 1979 test, 21 lines were selected for good performance at Gainesville, Tancasneque or at both locations. Jupiter, UFV-1, and "F75-9207," were added as checks to make 24 entries per test. These two tests were planted at Gainesville, Tancasneque, Tapachula and Boliche. The Boliche station is located in Ecuador, South America (2° 15' S-latitude).

The materials and methods for 1980 are also given in Table 3. Characters measured on a plot basis were the same as in 1979 evaluation.

Since Tapachula had nearly 1 meter of rainfall during the first 30 days after planting (1979) a complete loss of the experiments was suffered.

Table 3. Summary of materials and methods for the various tests (Experiment 1) by locations and years.+

Location‡	Year	Test no.	Date of planting	Entries no.	Replications no.	Rows per plot no.	Row length m	Row width m	Area harvested m^2
G	1978	single rows	19 July	621	1	1	2.5	0.90	2.25
	1979	A-1	24 July	40	2	2	6	0.90	9.00
	1979	A-2	24 July	40	2	2	6	0.90	9.00
	1980	A-3	18 July	24	3	4	6	0.90	9.00
	1980	A-4	18 July	24	3	4	6	0.90	9.00
T	1978	single rows	25 July	621	1	1	1.5	0.80	0.80
	1979	A-1	30 July	40	2	2	6	0.80	8.00
	1979	A-2	30 July	40	2	2	6	0.80	8.00
	1980	A-3	30 July	24	3	4	8	0.80	11.20
	1980	A-4	30 July	24	3	4	8	0.80	11.20
C	1980	A-3	3 July	24	3	4	7	0.61	7.32
	1980	A-4	3 July	24	3	4	7	0.61	7.32

Table 3—continued

Location‡	Year	Test no.	Date of planting	Entries no.	Replications no.	Rows per plot no.	Row length m	Row width m	Area harvested m^2
B	1980	A-3	17 July	24	3	4	8	0.90	12.60
	1980	A-4	17 July	24	3	4	8	0.90	12.60

+ Plots at all locations were irrigated one or more times.

‡ G, T, C, and B refer to Gainesville, Tancasneque, Tapachula (state of Chiapas), and Boliche, respectively.

Experiment 2

1978 Evaluation

Breeding lines were selected for their potential to produce cultivars adapted to late plantings in Florida. Ninety-four lines (from 296 grown) were selected from 1977 field plots. After harvest, these 94 lines were further reduced to 42 lines selected for high seed yield, diverse parentage, and growth characteristics expected to favor adaptation to tropical latitudes. The 42 lines selected were divided in two sets of 20 and 22 lines. Jupiter and UFV-1 were added as checks to make 22 and 24 entries per test. Tables 4 and 5 give the lines, parentage, and generation for entries in Test B-1 and Test B-2, respectively. These two tests were planted at Gainesville and Tancasneque.

Table 6 gives the date of planting, number of entries, number of replications, rows per plot, row length, row width, and area harvested by locations. Characters measured on a plot basis were the same as in Experiment 1.

1979, 1980 Evaluations

From the tests in 1978, 11 lines were selected from each test for their good performance in Gainesville, Tancasneque, or both locations. For 1979 and 1980 evaluations, the 11 lines selected from each test (B-1 and B-2) were combined into one test designated B-3 (1979) and B-4 (1980). Jupiter and UFV-1 were added as checks to make 24 entries. These tests were planted at Gainesville, Tancasneque, Tapachula and Boliche.

Table 4. Soybean breeding lines, their parentage and generation composited selected for Test 1978, B-1.

Line	Parentage	Generation composited
Jupiter	check	
UFV-1	check	
F76-6719	F64-2571 X (D60-7965 X F64-2862)	F_8
F76-6724	same	same
F76-6728	same	same
F76-7087	same	same
F76-7095	same	same
F76-7113	same	same
F76-7145	same	same
F76-7215	same	same
F76-7295	Jupiter X F66-1534	F_6
F76-7298	same	same
F76-7323	same	same
F76-7326	same	same
F76-7333	same	same
F76-7336	same	same
F76-6938	Jupiter subline	
F76-7000	Jupiter subline	
F76-7351	Hardee X (Bragg X PI 274,454)	F_6
F76-7376	same	same
F76-6854	F57-1471 X F58-3726	F_{15}
F76-6858	D49-2491 (2) X PI 230,201	F_{10}
F76-7162	Hill (2) X PI 274,454	F_7
F76-7205	UFV-1 subline	

Table 5. Soybean breeding lines, their parentage and generation composited selected for Test 1978, B-2.

Line	Parentage	Generation composited
Jupiter	check	
UFV-1	check	
D73-9360	Govan X (Hill X PI 274,454)	F_5
F74-2716	(D73-4747 X F61-3318) X Hardee	F_7
F74-3491	Cobb X [Hardee X (Bragg X PI 274-454)]	F_5
F75-7093	F61-3118 X (Bragg X F59-2496)	F_9
F75-9207	F74-2571 X (D60-7965 X F64-2862)	F_7
F75-9209	same	same
F76-6554	Hardee X PI 227,687	same
F76-6570	same	same
F76-9835	Cobb X (Hardee X FC33123)	same
F76-9967	Hardee (2) X PI 174,866	F_8
F76-0002	Hardee (2) X PI 171,438	same
F76-0007	same	same
F76-6875	Jupiter X F66-1534	F_4
F76-6883	same	same
F76-6884	same	same
F76-6918	Jupiter X F66-1537	same
F76-6928	Jupiter X F67-1533	same
F76-7233	Jupiter X F65-170	same
F76-7236	same	same
F76-7452	Cobb X (Hardee X [(Hill X PI 274,454) X Bragg])	F_5

Table 6. Summary of materials and methods for the various tests (Experiment 2) by locations and years.[+]

Location[‡]	Year	Test no.	Date of planting	Entries no.	Replications no.	Rows per plot no.	Row length m	Row width m	Area harvested m^2
G	1978	B-1	18 July	22	3	4	6	0.90	9.00
	1978	B-2	18 July	24	3	4	6	0.90	9.00
	1979	B-3	24 July	24	3	4	6	0.90	9.00
	1980	B-4	18 July	24	3	4	6	0.90	9.00
T	1978	B-1	25 July	22	3	3	8	0.80	5.60
	1978	B-2	25 July	24	3	3	8	0.80	5.60
	1979	B-3	30 July	24	3	4	6	0.80	8.00
	1980	B-4	15 July	24	3	4	8	0.80	11.20
C	1980	B-4	3 July	24	3	4	7	0.61	7.32
B	1979	B-3	19 June	24	3	4	6	0.90	10.80
	1980	B-4	17 July	24	3	4	8	0.90	12.60

[+]Plots at all locations were irrigated one or more times.

[‡]G, T, C, B refer to Gainesville, Tancasneque, Tapachula (state of Chiapas) and Boliche, respectively.

As was indicated before (Experiment 1), the Tapachula location (1979) had nearly 1 meter of rainfall during the first 30 days of planting; therefore, a complete loss of the experiment was suffered. Additional information on methods (date of planting, number of entries, number of replications, etc.) is given in Table 6 by locations and years. Characters measured on a plot basis were the same as in 1978 evaluation (see Experiment 1).

Statistical Analyses

For yield evaluations (Experiments 1 and 2) genotypes were arranged in randomized block designs with two or three replications. Analyses of variance were carried out for yield in each test at each location for each year using the mixed model:

$$Y_{ij} = \mu + G_i + B_j + e_{ij}$$

where,

Y = the observation from the i^{th} genotype in the j^{th} block

μ = the overall mean for all the observations

G_i = the fixed effect of the i^{th} genotype

B_j = the random effect of the j^{th} block

e_{ij} = the error in Y_{ij}

Expected mean squares for each source of variation are:

Source of variation	d.f.	E (MS)
Replications	$r-1$	$\sigma^2 e + g\sigma^2 r$
Genotypes	$g-1$	$\sigma^2 e + r\sigma^2 g$

Error $(g-1)(r-1)$ $\sigma^2 e$

where,

r = the number of replications

g = the number of genotypes

Combined analyses of variance were also performed. For these analyses, the model used was:

$$Y_{ijk} = \mu + G_i + B_j + L_k + GL_{ik} + e_{ijk}$$

where,

Y_{ijk} = the observation for the $i^{\underline{th}}$ genotype in the $j^{\underline{th}}$ block and $k^{\underline{th}}$ location

L_k = the random effect of the $k^{\underline{th}}$ location

GL_{ik} = the interaction effect of the $i^{\underline{th}}$ genotype on the $k^{\underline{th}}$ location

Expected mean squares for each source of variation are:

Source of variation	d.f.	E (MS)
Locations	$\ell-1$	$\sigma^2 A + r g \sigma^2_{\ell}$
Replications within locations	$\ell(r-1)$	$\sigma^2 A$
Genotypes	$g-1$	$\sigma^2 e + r\sigma^2_{g\ell} + r\ell\sigma^2_{g}$
Genotypes X locations	$(g-1)(\ell-1)$	$\sigma^2 e + r\sigma^2_{g\ell}$
Pooled error	$\ell(g-1)(r-1)$	$\sigma^2 e$

where,

ℓ = the locations

For genotypes evaluated two or more years, the following model was used:

$$Y_{ijk\ell} = \quad + G_i + B_j + L_k + Y_\ell + GL_{ik} + GY_{i\ell} + GLY_{ik\ell} + LY_{k\ell} + e_{ijk\ell}$$

where,

$Y_{ijk\ell}$ = the observation for the $i^{\underline{th}}$ genotype in the $j^{\underline{th}}$ block, in the $k^{\underline{th}}$ location and the $\ell^{\underline{th}}$ year

Y_ℓ = the random effect of the $\ell^{\underline{th}}$ year

$GY_{i\ell}$ = the interaction effect of the $i^{\underline{th}}$ genotype on the $\ell^{\underline{th}}$ year

$GLY_{ik\ell}$ = the interaction effect of the $i^{\underline{th}}$ genotype on the $k^{\underline{th}}$ location and the $\ell^{\underline{th}}$ year

Expected mean squares for each source of variation are shown below.

Source of Variation	d.f.	E (MS)
Years	y-1	$\sigma^2_A + r\sigma^2_{g\ell y} + rg\ell\sigma^2_y$
Locations	ℓ-1	$\sigma^2_A + r\sigma^2_{g\ell y} + rg\sigma^2_{y\ell} + rgy\sigma^2_\ell$
Years X Locations	$(y-1)(\ell-1)$	$\sigma^2_A + rg\sigma^2_{y\ell}$

Source of Variation	d.f.	E (MS)
Replications within Locations and Years	$y\ell(r-1)$	σ^2_A
Genotypes	$(g-1)$	$\sigma^2 e + r\sigma^2 g\ell y + ry\sigma^2 g\ell + r\ell\sigma^2 gy + ry\ell\sigma^2 g$
Genotypes X Years	$(g-1)(y-1)$	$\sigma^2 e + r\sigma^2 g\ell y + r\ell\sigma^2 gy$
Genotypes X Locations	$(g-1)(\ell-1)$	$\sigma^2 e + r\sigma^2 g\ell y + ry\sigma^2 g\ell$
Genotypes X Locations X Years	$(g-1)(\ell-1)(y-1)$	$\sigma^2 e + r\sigma^2 g\ell y$
Pooled Error	$y\ell(g-1)(r-1)$	$\sigma^2 e$

Simple correlation coefficients were calculated for some variables, depending on the interest to explain several important points.

During and at the end of Test 1, Experiment 1 (1979, A-1), a distinct soil gradient was observed at the Tancasneque

location, therefore an adjusted plot yield was made using the moving average procedure suggested by Dr. E. S. Horner[2] (1980, personal communication). We calculated the moving average for each plot using six adjacent plots (three on each side). The plot in question was not included. The average of the replication of the moving average values was divided by the moving average of a particular plot and this ratio was multiplied by the original plot yield. If the ratio was more than 1.0, the plot yield was increased proportionately. If the ratio was less than 1.0, the plot yield was reduced proportionately.

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RESULTS AND DISCUSSION

Experiment 1

At Gainesville, the 38 Tancasneque selections averaged 198 grams of seed per 1.0 meter of row length, and the 38 Gainesville selections averaged 285 grams of seed per 1.0 meter of row length, or 44% more.

At Tancasneque, the 38 Tancasneque selections averaged 145 grams of seed per meter of row length. Data on yield of Gainesville selections at Tancasneque were not recorded.

Although it is generally recognized that selection for superior-appearing (and superior-yielding) plant rows usually is little better than random selection, three observations suggested that selection at each location may have included rows with specific adaptation to that particular location. First, the 44% increase in average row yields at Gainesville for Gainesville selections over Tancasneque selections is substantial. Second, no rows selected at one location were included in selections at the other location. The 38 rows selected at each location represent 6% of the total; therefore, with random selection, 6% of 38 or two rows would be expected to be included in both groups. Third, soil properties at the two locations differ drastically. The Gainesville soil is sandy with pH corrected to no more than 6.2; whereas the Tancasneque soil is clay with a pH of about

8.0. Many 1978 Tancasneque rows showed evidence of iron chlorosis. For these reasons, 1979 and 1980 yield tests were designed and analyzed in ways to provide maximum information on the cultivar (breeding line) X location interactions.

1979 and 1980 Evaluations

The 38 selections from Gainesville and the 38 selections from Tancasneque were distributed equally between two tests designated 1979 A-1 and A-2 (Table 2). Each test contained 38 selected lines and two check cultivars. In 1980 the entries in each test were reduced to 21 breeding lines plus three checks. These tests are designated 1980 A-3 and 1980 A-4. Results from test 1979 A-1 and entries retained from it (Test 1980 A-3) will be discussed first. For convenience in discussing these future results, one term is needed to refer to a group of entries which includes both breeding lines and cultivars. The term "genotype" will be used for this purpose.

At Tancasneque in 1979, a soil gradient in the area where Test 1 was grown was especially noticeable. Replications were inadvertently arranged in a way to maximize (rather than minimize) soil variability within blocks. Some procedure to adjust plot values was needed to increase precision. The moving average, described in Materials and Methods, was used.

Table 7 shows mean squares for yield analyses at Gainesville and at Tancasneque with and without adjusted plot yields. Adjusting plot yields at Tancasneque reduced the

Table 7. Mean squares for yield of 40 soybean genotypes grown during 1979 at two locations. (Test 1979, A-1, without and with adjusted plot yields at Tancasneque.)

Source of variation	d.f.	Location analyses: Gainesville	Tancasneque[1+]	Tancasneque[2+]
Genotype	39	8.01*	20.58	8.31**
Jupiter vs rest	1	7.16	9.03	2.31
UFV-1 vs rest	1	0.61	25.22	34.92**
Gainesville vs Tancasneque (selections)	1	15.76*	2.05	1.28
Lines within groups	36	8.02*	21.28	7.93**
Error	39	3.55	11.36	3.22
Yield mean		2086	1587	1587
c.v.		9.03	21.24	11.30

Source of variation	d.f.	Combined analyses: Gainesville $\frac{1}{x}$ Tancasneque	Gainesville $\frac{2}{x}$ Tancasneque
Locations	1	996.70**	993.36**
Genotype	39	13.31	10.31*
Genotype x locations	39	15.28*	6.01*

Table 7—continued

Source of variation	d.f.	Combined analyses: Gainesville $\frac{1}{x}$ Tancasneque	Combined analyses: Gainesville $\frac{2}{x}$ Tancasneque
Error	78	7.45	3.38
Yield mean		1837	1837
c.v.		14.87	10.01

+, 1 and 2 indicates without and with adjusted plot yields respectively.

*, ** indicates significance at the 5% and 1% level respectively.

coefficient of variability from 21.24 to 11.30 and thereby increased significance levels of comparisons of primary interest. Therefore, adjusted yield values will be used in subsequent discussions.

The 40 genotypes means were significantly different at the 0.05 and 0.01 levels of significance at Gainesville and Tancasneque, respectively (Table 7). At Gainesville, neither Jupiter nor UFV-1 differed from the mean of the 38 test lines. At Tancasneque, Jupiter did not differ significantly from the mean of the test lines, but UFV-1 was significantly above the mean ($p<0.01$). However, when this source of variability was removed, highly significant differences among lines remained.

These observations illustrate two important points: (a) There is genetic variability for yield among test lines at both locations, and (b) the average yield of test lines is similar to that of the better check cultivars in the same maturity range.

Of particular interest, however, are the mean squares for Gainesville vs. Tancasneque selections. At Gainesville the mean square was significant at 0.05, but at Tancasneque it was not. At Gainesville, mean yields of the 19 lines selected at Gainesville (2135 kg/ha) was significantly larger than the mean of the 19 Tancasneque selections (2044 kg/ha); whereas at Tancasneque, the Gainesville and Tancasneque selections yielded 1561 and 1587 kg/ha, respectively. These data suggest that selection at Gainesville improved the yield

potential for Gainesville, but that selection at Tancasneque had no significant effect on the yield potential for Tancasneque. Detailed data on all genotypes at both locations are given in appendix Tables 1 and 2. Since four of the six highest yielding lines at Tancasneque were Tancasneque selections, there is a slight indication that selection at Tancasneque was also effective for Tancasneque.

After variation resulting from checks vs. selected lines and mean of Gainesville selections vs. Tancasneque selections was removed, 36 degrees of freedom remained for testing variation among lines within Gainesville and within Tancasneque selections. The mean square for lines within groups was significant at the 0.05 and 0.01 levels at Gainesville and Tancasneque, respectively (Table 7). This indicates about the same amount of variation for lines within groups as between groups at Gainesville and considerably more variation within than between at Tancasneque.

Table 7 also gives mean squares for combined analysis. There was a significant genotype effect over locations and the genotype X location interaction was significant. Evidence indicates that the significant genotype X location interaction was more likely due to unequal relative performance of lines within groups than to unequal performance of groups.

In order to identify genotypes which contributed greatly or slightly to the significant genotype X location interaction, the genotype mean was expressed in test mean

percentages at each location, a procedure used by Stuber et al. (1973). Genotype means, which vary from test means at each location by about the same percentage amount and in the same direction, contribute little to genotype X location interaction. These genotypes are identified in Table 8. Genotypes which vary from test means in different directions or by substantially different amounts contribute more to the interaction. These are identified in Table 9.

Sixteen lines contributed little to the interaction. Ten were Gainesville selections; six were Tancasneque selections. The correlation coefficient for yield at the two locations was 0.83 ($p < .01$).

Twelve lines and the two checks (Table 9) apparently contributed most to the genotype X location interaction. Nine were Tancasneque selections and three were Gainesville selections. The correlation coefficient for yield at the two locations was negative but nonsignificant ($r = -0.25$).

To summarize, the 1979 data showed significant genotype effects at each location and over both locations. It also indicated a significant genotype X location interaction and gave some indication that selection at a particular location improved performance at that location.

In 1980, 21 of the 38 lines were selected for retesting (Test 1980, A-3). Three checks were added to make 24 entries. Selected lines included those performing best at Gainesville, at Tancasneque, and at both locations in 1979. The 21 lines included nine which contributed little to the genotype X

Table 8. Mean yield of 16 soybean genotypes from Test 1979, A-1, which contributed little to the genotype x location interaction by kg/ha, rank, and as percent of overall test mean.

Genotype	Gainesville yield			Tancasneque yield			Source		
	Yield in kg/ha	Rank no.	Yield in %	Yield in kg/ha	Rank no.	Yield in %	Cross[+]	Selected at[+]	Retested 1980
F78-1129	2311	5	111	1738	8	110	1	G	Yes
F78-1133	2268	7	109	1709	13	108	2	G	Yes
F78-1162	2155	15	103	1688	14	106	2	G	Yes
F78-1206	2107	19	101	1657	16	104	2	T	Yes
F78-1622	1804	38	86	1414	30	89	10	G	No
F78-1639	1960	29	94	1532	25	97	10	G	Yes
F78-1077	2329	4	112	1717	11	108	1	T	Yes
F78-1095	2185	13	105	1607	21	101	1	T	No
F78-1424	2103	20	101	1535	24	97	7	G	No
F78-1572	1673	39	80	1326	37	84	10	T	No
F78-1015	2244	10	108	1630	20	103	1	G	No

Table 8—continued

Genotype	Gainesville yield			Tancasneque yield			Source		
	Yield in kg/ha	Rank no.	Yield in %	Yield in kg/ha	Rank no.	Yield in %	Cross+	Selected at‡	Retested 1980
F78-1195	2047	26	98	1647	18	104	2	T	Yes
F78-1141	2021	27	97	1654	17	104	2	G	No
F78-1160	2142	17	103	1751	7	110	2	G	Yes
F78-1169	2090	22	100	1469	28	93	2	G	Yes
F78-1430	1917	32	92	1572	23	99	7	T	No
Test Mean	2086		100	1837		100			

+ See table 1 for parents in each cross.

‡ G and T refer to Gainesville and Tancasneque respectively.

Table 9. Mean yield of 14 soybean genotypes from test 1979, A-1, which contributed most to the genotype x location interaction in kg/ha, rank, and as percent of overall test mean.

Genotype	Gainesville yield			Tancasneque yield			Source		Retested 1980
	Yield in kg/ha	Rank no.	Yield in %	Yield in kg/ha	Rank no.	Yield in %	Cross+	Selected at+	
F78-1448	1866	36	89	1961	2	124	8	T	Yes
F78-1411	2383	3	114	1348	34	85	7	T	Yes
F78-1562	2279	6	109	1345	35	85	10	T	Yes
UFV-1	2145	16	103	1998	1	126		check	Yes
F78-1573	2216	11	106	1355	32	85	10	T	No
F78-1130	2068	24	99	1883	4	119	1	G	Yes
F78-1428	1933	30	93	1193	40	75	7	G	Yes
F78-1196	2114	18	101	1334	36	84	2	T	No
F78-1096	2051	25	98	1804	6	114	1	T	No
F78-1134	2420	2	116	1590	22	100	2	G	Yes

Table 9—continued

Genotype	Gainesville yield: Yield in kg/ha	Gainesville yield: Rank no.	Gainesville yield: Yield in %	Tancasneque yield: Yield in kg/ha	Tancasneque yield: Rank no.	Tancasneque yield: Yield in %	Source: Cross[+]	Source: Selected at[‡]	Retested 1980
F78-1571	1932	31	93	1731	9	109	10	T	Yes
Jupiter	1897	33	91	1683	15	106	check		Yes
F78-1005	1860	37	89	1635	19	103	1	T	No
F78-1192	2258	9	108	1933	3	122	2	T	Yes
Test mean	2086		100	1837		100			

[+] See table 1 for parents in each cross.

[‡] G and T refer to Gainesville and Tancasneque respectively.

location in 1979 (Table 8) and 10 genotypes (including Jupiter and UFV-1) which contributed more to the interaction (Table 9). In 1980, replicated yield tests of these genotypes were conducted at four locations: Gainesville, Tancasneque, Tapachula, and Boliche. Because initial selections were made at Gainesville and Tancasneque, data from these two locations will be presented first, followed by data from Tapachula and Boliche.

Mean squares from analyses of data from Gainesville and Tancasneque are presented in Table 10. Genotype effects were highly significant at each location and in the combined analysis, but the genotype X location interaction was nonsignificant. This suggests that location effects were less important than year effects at one of the locations; therefore, analyses were performed with the group of genotypes studied in both years.

Mean squares from combined analyses for Gainesville 1979 vs. 1980 and Tancasneque 1979 vs. 1980 are presented in the bottom of Table 10. The genotype X year interaction was nonsignificant for Gainesville but highly significant for Tancasneque. Considering all four environments, data from Tancasneque 1979 appear to be more atypical.

Table 11 shows 1980 mean squares for yield at Tapachula and Boliche. The 24 genotype means were significantly different at the 0.01 level at Boliche, but nonsignificant at Tapachula. Detailed data on all genotypes at the four locations are given in Tables 3 and 4 of the Appendix.

Table 10. Mean squares for yield of 24 soybean genotypes grown during 1980 at two locations (Test 1980, A-3).

Location analyses

Source	d.f.	Gainesville	Tancasneque
Replications	2	342.19**	12.10*
Genotype	23	6.32**	11.33**
Error	46	2.81	3.23
Yield mean		1686	1594
c.v.		9.94	11.27

Combined analyses

Source	d.f.	Gainesville X Tancasneque
Location	1	30.84
Genotype	23	13.14**
Genotype X location	23	4.50
Error	92	3.02
Yield mean		1640
c.v.		10.59

Combined analyses for years at each location

Source	d.f.	Gainesville 1979 X 1980	Tancasneque 1979 X 1980
Year	1	157.62	17.38*
Genotype	22	11.13*	8.18
Genotype X year	22	4.55	6.12**

Table 10—continued

Source	d.f.	Gainesville 1979 X 1980	Tancasneque 1979 X 1980
Error	44	3.07	1.94
Yield mean		2006	1609
c.v.		8.73	8.65

*, ** Indicates significance at the 5% and 1% level, respectively.

Since this experiment was carried out at four locations in 1980, the mean squares for the interactions among these locations are of particular interest. Mean squares from analyses involving various location combinations are shown in Table 12.

The 24 genotype means were significantly different at the 0.01 level in three of the eight location combinations studied and significant at the 0.05 level in two other location combinations (Table 12). However, the genotype X location interaction was significant in only three of the eight combined analyses shown in Table 12 and it was not significant in another combination shown in Table 10.

Table 11. Mean squares for yield of 24 soybean genotypes grown during 1980 at two locations (Test 1980, A-3).

Source	d.f.	Tapachula	Boliche
Replications	2	11.58	4.64
Genotypes	23	47.03	24.53**
Error	46	29.53	8.22
Yield Mean		3046	1324
c.v.		17.84	21.66

** Indicates significance at the 1% level.

Table 12. Combined analyses for yield of 24 soybean genotypes grown in 1980 at four locations+ (Test 1980, A-3).

Source	d.f.	G X T X C X B	d.f.	G X T X C	G X T X B
Locations	3	4283.32**	2	4761.33**	255.41
Genotype	23	41.52**	23	31.97*	26.90**
Genotype X location	69	15.90*	46	16.35	7.64*
Error	184	10.95	138	11.85	4.75
Yield mean		1913		2109	1535
c.v.		17.30		16.33	1420

Source	d.f.	G X C	G X B	T X C	T X B	C X B
Location	1	6658.02**	473.06	7595.12**	262.33**	10680.53**
Genotype	23	32.56	22.74**	34.58	25.55*	43.66
Genotype X location	23	20.79	8.11	23.77	10.31*	27.90
Error	92	16.17	5.52	16.38	5.73	18.88
Yield mean		2366	1505	2320	1459	2185
c.v.		16.99	15.06	17.44	16.40	19.88

+, G, T, C, B Refer to Gainesville, Tancasneque, Tapachula (state of Chiapas) and Boliche, respectively.

*, ** Indicates significance at the 5% and 1% level, respectively.

In all nine location combinations studied, a significant genotype X location interaction was found only when both the Tancasneque (T) and the Boliche (B) locations were included. These two locations evidently represent the most extreme difference in relative performance of the 24 genotypes because interactions were not significant when data from either of these locations were used in combined analyses with data from either Gainesville (G) or Tapachula (C).

All possible two-location combinations were analyzed, but one combination of more than two locations was not analyzed. Analyses performed indicate that if either the Tancasneque or the Boliche location had been deleted, there would have been no genotype X location interaction.

Yield means (kg/ha) at the four locations were: Tapachula, 3046; Gainesville, 1686; Tancasneque, 1594; and Boliche, 1324. One might expect that locations having the largest differences in mean yield would have the largest genotype X location interaction. This was not true here. Tancasneque and Boliche had the lowest mean yields. The Boliche plots were under drought stress for a 24-day period during flowering. This contributed to the low yield, but its effect on the genotype X location interaction is unknown.

The primary purpose of this experiment, however, was to determine if selection at Gainesville can improve performance of soybean genotypes grown at tropical locations. The absence of a significant genotype X location interaction in all three location combinations involving Gainesville suggests that

such selection would be more likely to have a positive than a negative effect.

1979, A-2; 1980, A-4

The second group of plant rows selected at both Gainesville and Tancasneque in 1978 (Table 2) was evaluated in 1979 as test A-2, and reduced in number for 1980 evaluation in test A-4.

Table 13 shows mean squares from yield analyses at Gainesville and at Tancasneque in 1979. The 40 genotype means were significantly different at the 0.01 and 0.05 levels at Gainesville and Tancasneque, respectively (Table 13). At Gainesville and at Tancasneque, neither Jupiter nor UFV-1 differed from the mean of the 38 test lines.

The mean of Gainesville and Tancasneque selections did not differ significantly at either location. This suggests that initial selection at each location did not improve the yield potential for either location. The reasons selection was not effective at either location may include different environmental conditions in 1978 (year when the selection was made) and 1979 (year of evaluation); and possibly a wide range of adaptation for these selected lines. Detailed data on all lines at both locations are given in Appendix Tables 5 and 6.

The mean squares for lines within groups was significant at the 0.01 and 0.05 levels at Gainesville and Tancasneque respectively (Table 13). This indicates that there was variability for yield among test lines at both locations.

Table 13. Mean squares for yield of 40 soybean genotypes grown during 1979 at two locations (Test 1979, A-2).

Location analyses			
Source	d.f.	Gainesville	Tancasneque
Genotypes	39	16.59**	15.56*
Jupiter vs rest	1	.67	1.09
UFV-1 vs rest	1	2.60	.40
Gainesville vs Tancasneque selections	1	.03	9.65
Lines within groups	36	17.88**	16.54*
Error	39	4.50	8.04
Yield mean		1943	1652
c.v.		10.91	17.16

Combined analyses		
Source	d.f.	Gainesville X Tancasneque
Locations	1	337.50**
Genotypes	39	23.24**
Genotypes X locations	39	8.90
Error	78	6.27
Yield mean		1798
c.v.		13.92

*, ** Indicates significance at the 5% and 1% level, respectively.

Table 13 also gives mean squares for the combined analysis. There was a highly significant genotype effect over locations, but the genotype X location interaction was not significant.

The 21 lines selected for retesting in 1980 are listed in Table 14. Selected lines included those performing best at Gainesville, at Tancasneque, and at both locations. Ten and 11 selected lines were Tancasneque and Gainesville selections, respectively. Jupiter, UFV-1, and F75-9207 were added as checks to make 24 entries. Tests were grown in 1980 at Gainesville, Tancasneque, Tapachula, and Boliche.

Table 15 shows mean squares from yield analyses of data from Gainesville, Tancasneque, Tapachula, and Boliche. The 24 genotype means were significantly different at the 0.01 level at Tancasneque and Tapachula but nonsignificant at Gainesville and Boliche. Detailed data on all genotypes at the four locations are given in Tables 7 and 8 of the Appendix.

The mean squares for genotype X location interactions are of particular interest. Nine of the 10 possible location combinations were analyzed. Five of the nine genotype X location interactions were significant. All five included some combination of Tancasneque with Tapachula (T X C) or Tancasneque with Boliche (T X B). For purposes of this experiment, it is important to note that no two-location interaction involving Gainesville was significant. It is also important that genotype means were significantly different at the 0.01 level in six combined analyses, at the

Table 14. Mean yield of 21 soybean genotypes from Test 1979, A-2, which were selected for retesting (in 1980) in kg/ha, rank, and as percent of overall mean.

	Gainesville yield			Tancasneque yield		
	Yield in kg/ha	Rank no.	Yield in %	Yield in kg/ha	Rank no.	Yield in %
F78-1219	1818	27	94	1874	8	113
F78-1220	1968	18	101	1625	19	98
F78-1221	1756	31	90	2122	4	128
F78-1236	1560	37	80	1833	12	111
F78-1240	1788	29	92	1855	10	112
F78-1241	2305	5	119	1495	27	90
F78-1243	1913	21	98	1725	14	104
F78-1246	2121	10	109	1162	40	70
F78-1247	2120	11	109	1443	32	87
F78-1250	2651	1	136	1854	11	112
F78-1251	1954	19	101	1997	5	121
F78-1316	2133	9	110	1625	18	98
F78-1331	2335	4	120	2230	2	135
F78-1347	1883	23	97	1873	9	113
F78-1350	2073	14	107	1893	7	115
F78-1351	2367	3	122	1953	6	118
F78-1373	2177	7	112	1743	13	106
F78-1377	2580	2	133	2365	1	143
F78-1378	2262	6	116	1617	20	98
F78-1469	2027	16	104	1714	15	104
F78-1541	2167	8	112	2127	3	129

Table 15. Mean squares for yield of 24 soybean genotypes grown during 1980 at four locations+ (Test 1980, A-4).

Source	d.f.	Location analyses Gainesville	Tancasneque	Tapachula	Boliche
Replications	2	276.15**	13.49	7.50	125.76**
Genotypes	23	6.67	17.11**	19.57**	30.22
Error	46	4.65	6.02	6.23	19.65
Yield mean		1844	1740	3140	1535
c.v.		11.69	14.10	7.95	28.88

Source	d.f.	Combined analyses G X T X C X B	d.f.	G X T X C	G X T X B
Locations	3	3819.50**	2	4381.43**	177.95
Genotype	23	25.80	23	23.74**	17.56
Genotype X location	69	15.93**	46	9.81**	18.22**
Error	184	9.14	138	5.63	10.11
Yield mean		2065		2241	1706
c.v.		14.64		10.59	18.63

Table 15—continued

Source	d.f.	G X T	G X C	G X B	T X C	T X B	C X B
Locations	1	38.51	6050.90**	343.42	7054.88**	151.93	9277.06**
Genotype	23	15.10	17.55*	17.79	24.64*	20.46	29.63
Genotype X location	23	8.69	8.69	19.10	12.04*	26.88**	20.16
Error	92	5.33	5.44	12.15	6.12	12.84	12.94
Yield mean		1791	2492	1689	2440	1637	2337
c.v.		12.88	9.36	20.64	10.14	21.88	15.39

+, G, T, C, and B refer to Gainesville, Tancasneque, Tapachula and Boliche respectively

*, ** indicate significance at the 5% and 1% level respectively

0.05 level in one combination and nonsignificant in only two combinations.

Yield means (kg/ha) at the four locations were: Tapachula, 3140; Gainesville, 1844; Tancasneque, 1740; and Boliche, 1535. Similar results were found in 1980 Test A-3.

The results of Experiment 1 suggest that there is good potential for selecting genotypes adapted to late planting at Gainesville that will have good performance at lower latitudes or in short-day environments. However, agronomic characteristics are very important also, and selection for some of them at Gainesville may improve performance when plants are grown under short-day conditions.

To indicate which traits at Gainesville we need to consider for improving the potential for adaptation at Tancasneque, several correlations of yield with various agronomic characters were carried out. The results are given in Table 16.

Selection for high yield at Gainesville can improve yield at Tancasneque. All four r values were positive. Two were significant.

Within the range of variability represented by these lines, selection for late maturity, tall plants, and wide canopy will likely have a positive effect on yield at Tancasneque. Only one negative r value was obtained and it was low. One-half of all r values for each trait were significantly positive. The range in variation for each trait at both Gainesville and Tancasneque is shown in Table 17.

Table 16. Simple correlation coefficients of yield and some agronomic characteristics between Gainesville and Tancasneque by years and tests (Experiment 1).

Tancasneque trait[&] and test number		Gainesville 1 Yield kg/ha	2 Days to first flower	3 Days to maturity	4 Plant height cm	5 Seed weight g/100	6 Node number[+]	7 Canopy width[+]
1	1979, A-1	0.26	0.11	0.18	-0.02	0.23		
	1979, A-2	0.45**	-0.01	0.36*	0.40*	0.21		
	1980, A-3	0.51*	0.34	0.53**	0.43*	0.37	0.18	0.50*
	1980, A-4	0.30	0.10	0.38	-0.14	-0.25	0.00	0.03
2	1979, A-1	0.34*	0.93**	0.68**	0.73**	0.03		
	1979, A-2	0.01	0.83**	0.48**	0.38*	0.09		
	1980, A-3	0.30	0.96**	0.79**	0.70**	-0.03	0.54**	0.62**
	1980, A-4	-0.06	0.68**	0.45*	0.13	0.25	-0.19	0.11
3	1979, A-1	0.39*	0.77**	0.80**	0.73**	0.13		
	1979, A-2	0.33*	0.43**	0.71**	0.34*	0.10		
	1980, A-3	0.30	0.80**	0.85**	0.87**	0.17	0.69**	0.66**
	1980, A-4	0.07	0.29	0.88**	-0.03	-0.07	0.18	0.62**
4	1979, A-1	0.06	0.56**	0.35*	0.50**	-0.16		
	1979, A-2	0.30	0.26	0.34*	0.73**	0.47**		
	1980, A-3	0.26	0.65**	0.75**	0.93**	0.35	0.68**	0.58**
	1980, A-4	0.00	0.32	0.40	0.57**	0.37	0.55**	0.47*

Table 16—continued

Tancasneque trait[&] and test number		Gainesville 1 Yield kg/ha	2 Days to first flower	3 Days to maturity	4 Plant height cm	5 Seed weight g/100	6 Node number[+]	7 Canopy width[‡]
5	1979, A-1	-0.22	-0.77**	-0.57**	-0.67**	0.35**		
	1979, A-2	0.05	-0.18	-0.22	0.32*	0.87**		
	1980, A-3	0.02	-0.02	-0.11	0.08	0.51*	-0.05	0.72**
	1980, A-4	0.14	0.38	0.42*	0.06	0.53**	-0.18	0.24
6	1980, A-3	0.01	0.52**	0.50*	0.68**	0.03	0.90**	0.10
	1980, A-4	0.15	-0.09	-0.21	0.62**	0.22	0.72**	0.10

+, ‡ Nodes per plant at 1980 tests and canopy width only at Gainesville in 1980, respectively.

& For identification of Tancasneque traits, see corresponding number for Gainesville traits.

*, ** Indicates significance at the 5% and 1% level, respectively.

Table 17. Test means and ranges at Gainesville and Tancasneque for characters used in correlation analyses in Table 16.

Character	Location[+]	Tests							
		1979, A-1		1979, A-2		1980, A-3		1980, A-4	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
Days to first flower	G	33-53	44	37-51	45	41-60	48	44-57	50
	T	35-52	43	36-52	44	34-55	43	40-51	46
Days to maturity	G	92-124	111	103-124	112	100-132	118	112-130	119
	T	90-109	100	92-113	102	97-124	104	101-124	108
Plant height (cm)	G	49-117	86	49-115	83	42-112	69	55-90	74
	T	40-104	69	44-101	67	34-114	61	46-90	69
Grams/100 seeds	G	11.8-21.6	16.2	8.4-17.5	14.1	10.6-16.9	14.1	9.4-15.6	13.4
	T	11.0-19.0	14.4	8.0-16.0	13.5	12.0-17.0	14.4	11.0-16.0	13.5
Number of nodes	G					11-21	13	10-16	13
	T					8-18	11	9-17	13
Canopy width (cm)	G					45-70	50	50-70	60
Yield kg/ha	G	1589-2537	2086	1417-2651	1943	1298-1870	1686	1625-2125	1844
	T	1193-1998	1587	1162-2365	1652	1287-2156	1594	1268-2321	1740

[+] G and T refer to Gainesville and Tancasneque, respectively.

In general, plants at Gainesville had more days to maturity and were taller. Canopy width was not measured at Tancasneque.

Within the range of variability, days to first flower, node number, and grams per 100 seed at Gainesville had a small effect on yield at Tancasneque. Data in Table 17 show that the range in variation in these traits were sufficient to cause significant correlations if they were important.

Because days to maturity was significantly correlated with yield but days to first flower was not, more days from flowering to maturity probably was the important contribution of late maturity.

Some studies indicate significant positive correlations between yield and maturity (Kaw & Menon, 1972; Saxena & Pandey, 1971; Schapaugh & Wilcox, 1980), but negative correlations are also reported (Teixiera, 1977; Schapaugh & Wilcox, 1980). Brim (1980) pointed out that correlated responses to date do not appear to provide useful selection criteria for increased yield. The results are inconsistent from cross to cross and over environments.

It is possible, however, to select for characteristics which will increase the capacity of genotypes to yield well. When short plants limit the yielding capacity, for example, it is important to select for taller plants. The same logic prevails for other plant traits. For such selection to be effective, however, the selected trait must have a high heritability.

The heritability of the various traits measured in this study can be inferred from correlations between the same trait at the two locations. High positive r values indicate high heritabilities. Approximate heritability ranks are days to first flower > days to maturity = node number > plant height > grams/100 seed > yield. Inferred heritabilities are high enough to merit selection for any character having a significantly positive correlation with yield.

Experiment 2

1978 Evaluation

The 42 lines selected in 1977 were divided in two sets of 22 and 20 lines. Jupiter and UFV-1 were added as checks to make 24 and 22 entries per test. Tests are identified as 1978, B-1 and 1978, B-2. Genotypes were evaluated at Gainesville and Tancasneque. Table 17 shows mean squares for yield analyses.

In Test B-1 at Gainesville, there were significant yield differences among the 22 test lines, but the mean of the test lines did not differ significantly from either Jupiter or UFV-1. At Tancasneque, no significant difference among test lines was detected. However, the mean of the test lines was significantly less than Jupiter ($P<0.05$) and UFV-1 ($P<0.01$).

In the combined analysis for Test B-1, genotype means over both locations did not differ significantly, but there was a highly significant genotype X location interaction.

Table 18. Mean squares for yield of 24 and 22 soybean genotypes grown during 1978 at two locations (1978, B-1 and 1978, B-2).

Location analyses

Source	1978, B-1 d.f.	1978, B-1 Gainesville	1978, B-1 Tancasneque	1978, B-2 d.f.	1978, B-2 Gainesville	1978, B-2 Tancasneque
Genotype	23	22.19*	6.01*	21	31.01**	15.69*
Jupiter vs rest	1	13.60	12.59*	1	1.09	43.72*
UFV-1 vs rest	1	3.03	25.33**	1	9.59	4.15
Lines	21	23.52*	4.78	19	33.71**	14.82*
Error	46	11.44	2.63	42	11.31	7.69
Yield mean		1553	1268		1720	1293
c.v.		21.78	12.78		19.54	21.44

Combined analyses

Source	d.f.	Gainesville X Tancasneque	d.f.	Gainesville X Tancasneque
Location	1	291.04*	1	602.37
Genotype	23	9.64	21	22.34
Genotype X location	23	18.57**	21	24.36**
Error	92	7.04	84	9.50
Yield mean		1410		1506
c.v.		18.80		20.45

*, ** Indicates significance at the 5% and 1% level, respectively.

Test B-2 showed some similarities and some differences. At Gainesville, the 20 line means differed ($p < 0.01$), but the mean of these 20 lines did not differ significantly from either Jupiter or UFV-1. At Tancasneque, the line means differed ($p < 0.05$), and the mean of the 20 lines was significantly below Jupiter but not UFV-1.

In the combined analysis, the means of the genotypes over both locations were not significantly different (locations considered random), but the genotype X location interaction was significant at 0.01.

Considering both tests, all four genotype mean squares were significant and one was significant at 0.01. However, in combined analyses, neither genotype mean square was significant because the relative performance of many genotypes at the two locations differed, as is indicated by highly significant genotype X location interactions.

These results suggest that selection at Gainesville (for yield) is not likely to improve yield at Tancasneque. However, examination of individual line means (Appendix Tables 9 and 11) gives evidence that a few lines yielded equal to or better than check cultivars at both locations. Evidence for this can also be seen in Tables 19 and 20, particularly Table 19.

Table 19 identifies lines which contributed little to the genotype X location interaction and Table 20 identifies genotypes which contributed most. This procedure was described in the Experiment 1 discussion. Jupiter and UFV-1 were in the

Table 19. Mean yield of 11 and 10 soybean genotypes from Tests 1978, B-1 and B-2 respectively, which contributed little to the genotype X location interaction in kg/ha, rank, and as percent of overall test mean.

	1978, B-1					
	Gainesville yield			Tancasneque yield		
Cultivar	Yield in kg/ha	Rank no.	Yield in %	Yield in kg/ha	Rank no.	Yield in %
F76-7145	1497	14	96	1220	14	96
F76-7376	1459	17	94	1221	13	96
F76-6728[1]	1590	10	102	1341	7	106
F76-6854	1533	12	99	1210	16	95
F76-6724	1350	20	87	1171	19	92
F76-7205	1471	15	95	1146	20	90
F76-7323[1]	1648	7	106	1403	4	111
F76-7298	1554	11	100	1173	18	93
F76-7215[1]	1792	3	115	1357	6	107
F76-7295[1]	1752	6	113	1329	8	105
F76-7351[1]	1640	9	106	1243	12	98
Test mean	1553		100	1268		100

Table 19—continued

1978, B-2

Cultivar	Gainesville yield			Tancasneque yield		
	Yield in kg/ha	Rank no.	Yield in %	Yield in kg/ha	Rank no.	Yield in %
F74-3491	1499	18	87	1110	19	86
F75-9207[1]	2051	2	119	1549	4	120
F76-6570	1432	19	83	1112	18	86
F76-9967	1692	15	98	1304	12	101
F76-6875	1848	9	107	1330	9	103
F76-7233[1]	1835	10	107	1435	6	111
F76-7236[1]	1923	6	112	1366	8	106
F74-2716	1609	16	94	1326	11	103
F76-0002	1694	14	98	1150	16	89
F75-9209[1]	1968	5	114	1329	10	103
Test mean	1720		100	1293		100

[1] Lines selected for retesting in 1979 and 1980, relatively good at both locations.

Table 20. Mean yield of 9 and 12 soybean genotypes from Tests 1978, B-1 and B-2 respectively, which contributed most to the genotype X location interaction in kg/ha, rank, and as percent of overall test mean.

1978, B-1

Cultivar	Gainesville yield			Tancasneque yield		
	Yield in kg/ha	Rank no.	Yield in %	Yield in kg/ha	Rank no.	Yield in %
F76-7087[2]	2301	1	148	1043	24	82
F76-6858	887	24	57	1321	9	104
F76-6938[3]	1422	19	92	1599	1	126
Jupiter	1348	21	87	1457	3	115
UFV-1	1463	16	94	1544	2	122
F76-7095[2]	1931	2	124	1215	15	96
F76-6719[2]	1765	4	114	1113	21	88
F76-7162	1161	23	75	1283	11	101
F76-7336	1761	5	113	1100	22	87
Test mean	1553		100	1243		100

Table 20—continued

1978, B-2

Cultivar	Gainesville yield: Yield in kg/ha	Gainesville yield: Rank no.	Gainesville yield: Yield in %	Tancasneque yield: Yield in kg/ha	Tancasneque yield: Rank no.	Tancasneque yield: Yield in %
F76-9835[3]	1356	21	79	1695	1	131
F75-7093[2]	1914	7	111	782	22	60
F76-6554	698	22	41	1134	17	88
F76-0007[2]	2183	1	127	1154	15	89
F76-6928[3]	1363	20	79	1495	5	116
D73-9360	1887	8	110	993	21	77
Jupiter	1787	16	104	1661	2	128
F76-6918[2]	1969	4	114	1178	14	91
F76-7452	1796	11	104	1041	20	81
F76-6883[3]	1769	13	103	1604	3	124
UFV-1	1542	17	90	1390	7	108
F76-6884[2]	2024	3	118	1300	13	101
Test mean	1720		100	1293		100

[2] Lines selected for retesting in 1979 and 1980, good at Gainesville.

[3] Lines selected for retesting in 1979 and 1980, good at Tancasneque.

group considered to contribute most to the interaction in both tests, because of their better performance, relative to test lines, at Tancasneque.

The small contribution to the genotype X location interaction for lines listed in Table 19 is further illustrated by high correlation coefficients for yield at the two locations for lines in Table 19 ($r = 0.77^{**}$ and $r = 0.84^{**}$ for lines in Test B-1 and B-2, respectively).

Conversely, the large contribution to the interaction is illustrated by negative r values for genotypes listed in Table 20 ($r = -0.59$ and $r = -0.25$ for Test B-1 and B-2, respectively).

1979, 1980 Evaluations

From the 42 breeding lines in 1978 Tests B-1 and B-2, 22 lines were selected for testing in 1979 and 1980. In the group selected, nine performed well at both locations, seven performed well at Gainesville only, and four performed well at Tancasneque only. Two more lines and Jupiter and UFV-1 checks were added to make 24 entries. The 1979 and 1980 tests are identified as B-3 and B-4, respectively.

The 1978 tests (B-1 and B-2) served to refine hypotheses on the feasibility of selecting at Gainesville to improve performance in more tropical environments, represented by Tancasneque in this particular experiment. The highly significant genotype X location interaction for both 1978 tests is evidence that some lines had significantly different relative performances at the two locations.

The cause of the genotype X location interaction appeared to be associated more with differential responses to environmental conditions than to differences in plant characteristics such as height and maturity. This suggests that the latitude difference (29 vs 23°) was relatively unimportant.

Because soil properties at the two locations differ greatly (sandy soil, low pH, high P, low K vs clay soil, pH 8.0, low P, high K), this was considered the most probable cause of the highly significant genotype X location interactions. The presence of Fe chlorosis in some 1978 plots at Tancasneque, apparently associated with high soil pH, was considered additional evidence that a differential response to soil properties could have caused the interaction. Another factor could be environmental effects associated with year difference at one location in 1978, but this was not considered seriously in planning 1979 and 1980 tests.

If a differential response to soil properties was the primary cause of the interaction, including seven lines that performed well at Gainesville only, and four lines that performed well at Tancasneque only, in the 1979-80 tests would be expected to result in significant genotype X location interactions in 1979 and 1980. Since both check varieties, Jupiter and UFV-1, tended to be superior at Tancasneque, but not at Gainesville, the high performing entries at Tancasneque is increased to six.

To obtain a better estimate of the extent to which soil

pH per se causes differences in relative performance, genotypes in 1979 and 1980 tests (B-3 and B-4) were also evaluated at Tapachula, Mexico (soil pH 5.1) and Boliche, Ecuador (pH 6.7). Although not stated previously, these considerations were the primary reasons for growing Experiment 1 plots in both Tapachula and Boliche in 1980.

Results from 1979 and 1980 tests at Gainesville and Tancasneque will be presented first for two reasons: (a) The experiment was originally planned to compare responses at Gainesville and Tancasneque, and (b) data from Tapachula and Boliche were received after analyses of available data were underway. Results from Tapachula and Boliche will follow.

Table 21 shows mean squares for yield analyses at Gainesville and Tancasneque in 1979 and 1980. The 24 genotype means were significantly different at the 0.01 level at Tancasneque both years, but at Gainesville, differences were not significant. At Tancasneque both Jupiter and UFV-1 yielded significantly more than the mean of the 22 test lines in 1979, but not in 1980. This suggests the possibility of a genotype X year effect at Tancasneque.

Combined analyses by years (Table 21) show no significant genotype effect over locations either year, but a highly significant genotype X location interaction both years.

Further analyses of these data are presented in Table 22. Combined analyses over years at each location show no significant genotype X year effect at Gainesville, but a highly significant genotype X year effect at Tancasneque.

Table 21. Mean squares for yield of 24 soybean genotypes grown during 1979 and 1980 at two locations (Tests 1979, B-3 and 1980, B-4).

		Location analyses			
		1979, B-3		1980, B-4	
Source	d.f.	Gainesville	Tancasneque	Gainesville	Tancasneque
Genotype	23	11.66	18.65**	6.85	21.19**
Jupiter vs rest	1	.00	34.81**	2.14	3.39
UFV-1 vs rest	1	8.19	36.43**	.22	24.87
Within lines	21	12.39	17.03**	7.40	21.86**
Error	46	10.38	3.78	8.28	6.51
Yield mean		1613	1538	1943	2182
c.v.		19.98	12.64	14.81	11.69

Table 21—continued

		Combined analyses	
	d.f.	Gainesville X Tancasneque	Gainesville X Tancasneque
Locations	1	20.21	206.38
Genotype	23	15.38	12.41
Genotype X location	23	14.93**	15.64**
Error	92	7.08	7.39
Yield mean		1575	2063
c.v.		16.98	13.18

** Indicates signficance at the 1% level.

The highly significant genotype X year effect at Tancasneque could be caused by climatic differences, moving plots to a different field, or both. In Mexico, large ecological differences often occur within short distances (Marquez, 1976).

Table 22 also shows mean squares for effects over locations and years. The genotype X location X year interaction was not significant, but the genotype X location interaction was significant. LeClerg et al. (1962) state that when the interaction of varieties X locations significantly exceeds varieties X locations X years, it is clear that the differential response of the varieties at the individual locations was sufficiently similar in the different years to warrant the conclusion that these differential responses may be permanent features for these locations.

The following conclusions seem appropriate based on LeClerg's statement and on the data in Tables 21 and 22.

1. The 24 genotypes performed similarly at Gainesville in both 1979 and 1980, but differently at Tancasneque both years.

2. Genotypic differences at Tancasneque over years persisted despite the significant genotype X year interaction.

3. A significant amount of the genotype X location interaction each year is a permanent feature of the two environments.

4. The differential location response results from nearly equal performance of the 24 genotypes at Gainesville and

Table 22. Mean squares for yield of 24 soybean genotypes grown during two years at two locations.

Source	d.f.	Combined analyses for years at each location: Gainesville 1979 X 1980	Tancasneque 1979 X 1980
Year	1	392.87	1496.27**
Genotype	23	9.16	26.61*
Genotype X year	23	9.36	13.23**
Error	92	8.98	5.14
Yield mean		1778	1860
c.v.		16.86	12.19

Source	d.f.	Combined analyses over locations and years
Year	1	1711.27
Location	1	48.72
Year X location	1	177.86
Replications within location and years	8	126.75
Genotype	23	13.57
Genotype X year	23	14.21
Genotype X location	23	22.20*
Genotype X location X year	23	8.37
Pooled error	184	7.24
Yield mean		1819
c.v.		14.79

*, ** Indicates significance at the 5% and 1% level, respectively.

unequal performance at Tancasneque.

Conclusion 3 above was based primary on LeClerg's statement, but it is supported by the significant genotype effect over years at Tancasneque, tested against the genotype X year interaction (Table 22). However, using the procedure from Stuber et al. (1973), we attempted to determine if genotypes tended to be consistent in their yield relationship between locations over years. Yield of each genotype was expressed as percentage of each test mean as before. Genotypes are listed in Table 23 in order from smallest to largest difference in percentage values between locations. The left side of Table 23 lists the order for 1979; the right side for 1980. We found no consistency in the listings. As before, genotypes with small differences in percentage yield were considered to contribute little to the genotype X location interaction for that year. Those with large differences were considered to contribute most. So far as we could determine from data in Table 23, the group of genotypes contributing most to the genotype X location in 1979 was nearly random, relative to the group contributing most in 1980. Further the seven lines selected in 1978 for good performance at Gainesville only and the four lines selected for good performance at Tancasneque only seemed to appear at random in the 1979 and 1980 listings. These observations suggest that in addition to the "permanent feature of the environment" stated in conclusion 3, a significant amount of variation associated with other effects remains. These other effects are presumed to be

Table 23. Mean yield of 24 soybean genotypes grown during 1979 and 1980 at two locations in kg/ha, rank, and as percent of overall test mean.

			1979, B-3					
			Gainesville			Tancasneque		
Rank[+]	Genotype	Selected for[&]	Yield in kg/ha	Rank no.[‡]	Yield in %	Yield in kg/ha	Rank no.[‡]	Yield in %
1	F76-6719	2	1622	12	101	1576	11	102
2	F76-6728	1	1455	21	90	1355	18	88
3	F76-7000		1675	10	104	1649	8	107
4	F76-9835	3	1811	4	112	1769	5	115
5	F76-6928	3	1542	17	96	1583	10	103
6	F76-7113		1616	13	100	1426	15	93
7	F75-9207	1	1634	11	101	1437	14	93
8	UFV-1		1775	6	110	1865	3	121
9	F76-6918	2	1702	9	106	1446	13	94
10	F76-7295	1	1490	19	92	1592	9	104
11	F76-6884	2	1770	7	110	1889	2	123
12	F76-7215	1	1463	20	91	1198	24	78
13	F76-6883	3	1260	23	78	1411	16	92
14	F76-7323	1	1607	14	100	1315	19	86
15	F76-7351	1	1540	18	95	1672	7	109
16	Jupiter		1602	15	99	1857	4	121
17	F76-7095	2	1931	1	120	1488	12	97
18	F76-7087	2	1723	8	107	1288	20	84
19	F76-0007	2	1085	24	67	1388	17	90
20	F75-9209	1	1784	5	111	1273	21	83
21	F76-6938	3	1370	22	85	1758	6	114
22	F76-7236	1	1839	3	114	1252	22	81
23	F75-7093	2	1855	2	115	1251	23	81
24	F76-7233	1	1551	16	96	2164	1	141
Test mean			1613		100	1538		100

[+] Rank from smallest to largest yield deviations between locations expressed as percentage of test mean.

[‡] Rank from highest to lowest mean yield at each location.

[&] Lines selected in 1978 for good performance at Gainesville (2), at Tancasneque (3), or both locations (1).

Table 23—extended

Rank 1979	Rank 1980	Genotype	Selected for	1980, B-4 Gainesville Yield in kg/ha	Gainesville Rank no.	Gainesville Yield in %	Tancasneque Yield in kg/ha	Tancasneque Rank no.	Tancasneque Yield in %
17	1	F76-7095	2	1905	13	98	2116	16	97
19	2	F76-0007	2	2105	5	108	2405	5	110
4	3	F76-9835	3	2136	4	110	2332	9	107
11	4	F76-6884	2	1975	9	102	2138	13	98
21	5	F76-6938	3	2039	8	105	2383	7	109
2	6	F76-6728	1	1932	12	99	2056	18	94
7	7	F75-9207	1	1902	14	98	1992	19	91
16	8	Jupiter		1859	17	96	2274	11	104
20	9	F75-9209	1	1830	18	94	1875	21	86
9	10	F76-6918	2	1783	21	92	2185	12	100
15	11	F76-7351	1	1690	24	87	1738	23	79
5	12	F76-6928	3	1936	11	100	1982	20	91
14	13	F76-7323	1	1882	15	97	2341	8	107
8	14	UFV-1		1973	10	102	2460	2	113
18	15	F76-7087	2	2140	3	110	2135	14	98
13	16	F76-6883	3	1867	16	96	2435	4	112
24	17	F76-7233	1	1798	20	93	2396	6	110
12	18	F76-7215	1	2221	2	114	2122	15	97
1	19	F76-6719	2	1727	23	89	2310	10	106
6	20	F76-7113		1825	19	94	2446	3	112
22	21	F76-7236	1	2229	1	115	2078	17	95
10	22	F76-7295	1	2055	6	106	1784	22	82
23	23	F75-7093	2	2042	7	105	1632	24	75
3	24	F76-7000		1781	22	92	2762	1	127
				1943		100	2182		100

primarily due to inconsistent performance of genotypes at Tancasneque from year to year.

The evidence that differential responses between Gainesville and Tancasneque may be permanent features for these locations is evidence that rigid selection for yield at Gainesville will not necessarily improve yield at Tancasneque. However, there is about as much evidence that rigid selection for yield at Tancasneque in 1979 would not have improved relative yield in 1980. At this point it appears that a modest level of selection for yield at Gainesville would be as likely to be beneficial as detrimental.

Table 24 presents correlation coefficients between various combinations of characters measured from 1978 through 1980. Of the 18 correlation coefficients calculated between characteristics measured at Gainesville and yield at Tancasneque, only one was significant. However there was variation among lines for all agronomic traits measured. The absence of more significant correlations between agronomic characteristics and yield does not mean that agronomic characteristics have no effect on yield. It only means that initial selection included the proper range in days to first flower, days to maturity, and plant height. If cultivars adapted to southern U.S. had been included, positive correlation coefficients would have been expected between yield at Tancasneque and days to first flower, plant height, and maturity at Gainesville.

Correlations among plant height, days to maturity, and

Table 24. Simple correlation coefficients of yield and some agronomic characteristics between Gainesville and Tancasneque by years and tests (Experiment 2).

Tancasneque trait+ and test number		Gainesville 1 Yield kg/ha	2 Days to first flower	3 Days to maturity	4 Plant height cm	5 Seed weight g/100
1	1978, B-1	-0.39	0.07	0.04	-0.02	
	1978, B-2	-0.05	0.37	0.52*	0.30	
	1979, B-3	0.01	0.36	0.40	0.32	0.19
	1980, B-4	-0.13	-0.01	-0.07	-0.37	-0.38
2	1978, B-1	-0.13	0.89**	0.76**	0.30	
	1978, B-2	-0.13	0.91**	0.65**	0.65**	
	1979, B-3	-0.33	0.93**	0.72**	0.60**	0.15
	1980, B-4	-0.27	0.86**	0.48*	0.38	0.36
3	1978, B-1	0.29	0.43*	0.78**	0.35	
	1978, B-2	-0.25	0.60**	0.73**	0.27	
	1979, B-3	-0.18	0.68**	0.77**	0.38	0.00
	1980, B-4	-0.19	0.51*	0.78**	0.35	-0.19
4	1978, B-1	-0.06	0.60**	0.57**	0.62**	
	1978, B-2	0.23	0.37	0.48*	0.63**	
	1979, B-3	-0.10	0.66**	0.58**	0.77**	0.33
	1980, B-4	-0.33	0.61**	0.62**	0.53**	0.36
5	1979, B-3	0.25	-0.01	0.00	0.34	0.41*
	1980, B-4	-0.07	-0.08	-0.48*	-0.07	0.52**

+ For identification of Tancasneque traits, see corresponding number for Gainesville traits.

*, ** Indicates significance at the 5% and 1% level, respectively.

days to first flower are moderately strong, indicating that selection for one of these traits will influence the other two.

Inferences on heritability can be made from the magnitude of the correlation coefficients for the same traits at the two locations. Indicated heritability ranks are days to first flower > maturity date > plant height > grams/100 seed > yield, the same order as indicated for these traits in Experiment 1 (Table 16).

Table 25 shows mean squares for yield analyses at Boliche (1979, B-3 and 1980, B-4) and Tapachula (1980, B-4). The 24 genotype means were significantly different at the 0.01 level at Boliche in 1979 and at the 0.05 level at both locations in 1980. At Boliche both Jupiter and UFV-1 yielded significantly more than the mean of the 22 test lines in 1979, but not in 1980. This suggests the possibility of genotype X year effect at Boliche. Highly significant differences among lines within groups were detected at Boliche in both years. At Tapachula, neither Jupiter nor UFV-1 differed from the mean of the 22 test lines. Also, no significant differences among lines within groups existed.

These results illustrate that there is genetic variability for yield among genotypes at both locations. Average yield of some test lines is similar to that of the check varieties. Detailed data on all lines by locations and years are given in Appendix Tables 13 through 16.

Table 25. Mean squares for yield of 24 soybean genotypes grown during 1979 (Boliche) and 1980 (Boliche and Tapachula).

		Location analyses		
		Boliche		Tapachula
Source	d.f.	1979, B-3	1980, B-4	1980, B-4
Genotype	23	69.85**	26.54*	29.57*
Jupiter vs rest	1	39.08*	13.59	27.10
UFV-1 vs rest	1	35.76*	.23	55.30
Within lines	21	72.94**	28.40**	28.46
Error	46	8.44	10.61	16.28
Yield mean		2259	1472	3133
c.v.		12.86	22.12	12.88

*, ** Indicates signficance at the 5% and 1% level, respectively.

Since these tests were also carried out in 1979 and 1980 at Gainesville and Tancasneque, the mean squares for the interactions among the seven environments are of particular interest. Therefore, further analyses were done considering all possible combinations among years and locations. The results are given in Table 26. The genotype X environment interaction was significant in 18 of 21 combined analyses.

The genotype X year interaction was not significant for the Gainesville location, but was highly significant for both Tancasneque and Boliche (Table 26). Therefore, each test year at both Tancasneque and Boliche represents distinctly different environments.

There is little evidence from F values in Table 26 that performance at Tancasneque in 1979 predicted performance at Tancasneque in 1980 any better than performance in Gainesville in either year predicted performance at Tancasneque either year. The F value for the genotype X environment interaction for Tancasneque 1979 vs 1980 was 2.57**. For Gainesville 1979 vs Tancasneque 1979 and 1980, the F values were 2.11** and 2.38**, respectively. For Gainesville 1980 vs Tancasneque 1979 and 1980, values were 2.71** and 2.12**, respectively. Similar relationships existed for Boliche and Gainesville.

Considering the significance level and magnitude of all values in Table 26, it appears that each environment

Table 26. Significance and F values for genotypes x environment interactions in 21 combined analyses of 24 soybean genotypes grown at four locations in 1979 and 1980.

	G79	G80	T79	T80	B79	B80	C80
Genotype effect	NS	NS	**	**	**	*	*
c.v.	19.98	14.81	12.64	11.69	12.86	22.12	12.88
G79		NS	**	**	**	*	*
		1.04	2.11	2.38	4.01	1.96	1.79
G80			**	**	**	*	NS
			2.71	2.12	5.01	1.93	1.04
T79				**	**	**	NS
				2.57	3.42	2.52	1.53
T80					**	**	**
					5.05	2.76	2.11
B79						**	**
						4.92	2.28
B80							**
							2.31

Environments	Comparison made	Number N.S.	5%	1%
G Gainesville 1979	6	1	2	3
G Gainesville 1980	6	2	1	3
T Tancasneque 1979	6	1	0	5
T Tancasneque 1980	6	0	0	6
B Boliche 1979	6	0	0	6
B Boliche 1980	6	0	2	4
C Tapachula 1980	6	2	1	3

predicted relative performance in all other environments in the following order: Tapachula 80 $\geq$ Gainesville 80 $\geq$ Gainesville 79 $\geq$ Tancasneque 79 $\geq$ Boliche 80 $\geq$ Tancasneque 80 $\geq$ Boliche 79.

Data in Table 26 indicate considerably different responses from location to location, and also from year to year at Tancasneque and Boliche. The two Gainesville environments, which were not significantly different from each other, were among the best predictors of all other environments.

Table 27 gives yield for each genotypes at each location expressed as percent of the test mean for that particular location. These data are useful for estimating stability over environments or identifying genotypes which have unusual performance trends.

Some genotypes were very stable over environments. The standard deviations (Table 26) suggest that F76-6728, UFV-1, F76-6918, and F76-6884 were more stable than other genotypes. Except for one unusally high or low yield, F76-6928, F76-76-7095, and F76-9835 would have been included.

Genotypes with the highest mean yield over all environments tended to be more stable across environments, but there were exceptions. When two genotypes (F76-7233 and F76-6728) were eliminated from the array of means and standard deviations (Table 27) the correlation coefficient

Table 27. Mean yield of 24 soybean genotypes as percent of the test mean and environment, mean and standard deviation.

Genotype	Gainesville 1979	Gainesville 1980	Tancasneque 1979	Tancasneque 1980	Boliche 1979	Boliche 1980	Tapachula 1980	Mean	Standard deviation
Jupiter	99	96	121	104	115	86	109	104	11.88
UFV-1	110	102	121	113	114	99	113	110	7.52
F75-9207	101	98	93	91	57	116	97	93	17.95
F75-9209	111	94	83	86	61	93	91	88	15.03
F75-7093	115	105	81	75	90	54	104	89	20.99
F76-0007	67	108	90	110	88	90	107	94	15.37
F76-6719	101	89	102	106	106	121	83	101	12.37
F76-6728	90	99	88	94	81	87	91	90	5.66
F76-6883	78	96	92	112	82	102	107	96	12.56
F76-6884	110	102	123	98	124	112	113	112	9.71
F76-6918	106	92	94	100	112	83	98	98	9.49
F76-6928	96	100	103	91	119	86	103	100	10.58
F76-6938	85	105	114	109	119	93	106	104	11.80
F76-7000	104	92	107	127	100	81	95	101	14.37
F76-7087	107	110	84	98	83	77	95	93	12.58
F76-7095	120	98	97	97	102	84	82	97	12.57
F76-7113	100	94	93	112	81	128	81	98	16.22
F76-7215	91	114	78	97	70	101	95	92	14.60
F76-7233	96	93	141	110	140	93	112	112	20.84
F76-7236	114	115	81	95	120	109	112	107	13.72
F76-7295	92	106	104	82	101	125	110	103	13.59
F76-7323	100	97	86	107	123	108	105	104	11.37
F76-7351	95	87	109	80	114	138	92	102	19.78
F76-9835	112	110	115	107	97	135	101	111	12.29
Mean of 24%	100	100	100	100	100	100	100		
Mean kg/ha	1613	1942	1538	2182	2259	1472	3133		

between means and standard deviations is r=-0.56**. However, with F76-7233 and F76-6728 r=-0.15. F76-7233 was relatively poor at Gainesville but very good in nearly all tropical environments.

When all points are considered, it appears that very rigid selection for performance at Gainesville will eliminate some genotypes which perform well at low latitudes (F76-7233 for example), but that a modest level of selection would be beneficial. The latter would tend to eliminate types with generally low performance in all environments.

SUMMARY AND CONCLUSIONS

Experiments were conducted to measure relative performance of soybean genotypes planted in mid-July at Gainesville, Florida, U.S.A., and in tropical environments. Relative performance between Gainesville and Tancasneque, Tamaulipas, Mexico (22° 13' N-latitude) was emphasized. The purpose was to determine the extent to which selection at Gainesville would affect performance in tropical environments.

Initial plant material was in two developmental stages. In Experiment 1, individual plants selected at Gainesville in 1977 were advanced in plant rows at both Gainesville and Tancasneque in 1978. Breeding lines established from selected rows at both locations provided material for replicated trials in 1979 and 1980. In Experiment 2, breeding lines which had survived preliminary yield tests at Gainesville were chosen.

Seed yields in tropical environments often equalled or exceeded seed yield at Gainesville. In nearly all environments, there were significant yield differences among genotypes.

In Experiment 1, few genotype X location interactions were significant, indicating that relative performance in one environment was a good indicator of relative performance in other environments.

Genotype X environment interactions in Experiment 2 indicated much more inconsistent performance among genotypes, not only among locations, but also between years at Tancasneque and Boliche. The two Gainesville environments were among the more reliable indicators of overall yield performance.

Environments included locations at 29° 30', 22° 13', and 14° 59' N-latitude and 2° 15' S-latitude. The generally good agreement in relative performance between Gainesville (29° 30') and Tapachula (14° 59') suggests that latitude effects were relatively unimportant in this study.

Results from Experiment 1 indicate that selections at Gainesville would improve performance in tropical environments. Results from Experiment 2 are less encouraging. One of the better performing lines in nearly all tropical environments would have been discarded if very rigid selection for yields had been practiced at Gainesville.

Although lines in Experiment 2 had undergone more rigid selection at Gainesville before being chosen for these tests, data are insufficient to determine if the added selection pressure influenced the differences between Experiments 1 and 2.

Correlation coefficients indicate that selecting for the taller, later types in Experiment 1 would improve yields at Tancasneque slightly. In Experiment 2, correlations were weaker. Although genotypes differed in height, maturity, and other agronomic traits, they did not differ

drastically from Jupiter in these characteristics. Initial selection of lines evidently included the proper range of plant types.

APPENDIX

Table 1. Mean yield of 40 soybean genotypes grown during 1979 at two locations in kg/ha, rank and as percent of overall test mean. (Test 1979, A-1). Duncan's test at .05 level.

Geno-type	Se-lec-ted at	Gainesville yield				Tancasneque yield			
		Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
Jupiter		1897	F-H	33	91	1683	A-H	15	106
UFV-1		2145	A-F	16	103	1998	A	1	126
F78-1005	T	1860	E-H	37	89	1635	A-H	19	103
F78-1015	G	2244	A-F	10	108	1630	A-I	20	103
F78-1045	G	2267	A-F	8	109	1525	B-I	26	96
F78-1077	T	2329	A-D	4	112	1717	A-G	11	108
F78-1089	T	2167	A-F	14	104	1837	A-E	5	116
F78-1095	T	2185	A-F	13	105	1607	A-I	21	101
F78-1096	T	2051	B-F	25	98	1804	A-E	6	114
F78-1128	G	2537	A	1	122	1727	A-F	10	109
F78-1129	G	2311	A-E	5	111	1738	A-F	8	110
F78-1130	G	2068	B-G	24	99	1883	A-D	4	119
F78-1133	G	2268	A-F	7	109	1709	A-G	13	108
F78-1134	G	2420	A-B	2	116	1590	A-I	22	100
F78-1141	G	2021	B-H	27	97	1654	A-H	17	104
F78-1160	G	2142	A-F	17	103	1751	A-F	7	110
F78-1162	G	2155	A-F	15	103	1688	A-H	14	106
F78-1169	G	2090	A-G	22	100	1469	D-I	28	93
F78-1186	T	1991	B-H	28	95	1714	A-G	12	108
F78-1192	T	2258	A-F	9	108	1933	A-C	3	122
F78-1195	T	2047	B-G	26	98	1647	A-H	18	104
F78-1196	T	2114	A-G	18	101	1334	F-I	36	84
F78-1202	G	2200	A-F	12	105	1512	C-I	27	95
F78-1206	T	2107	A-G	19	101	1657	A-H	16	104
F78-1411	T	2383	A-C	3	114	1348	F-I	34	85
F78-1424	G	2103	A-G	20	101	1535	B-I	24	97
F78-1428	G	1933	C-H	30	93	1193	I	40	75
F78-1429	G	2091	A-G	21	100	1411	E-I	31	89
F78-1430	T	1917	C-H	32	92	1572	A-I	23	99
F78-1448	T	1866	D-H	36	89	1961	A-B	2	124
F78-1457	T	1589	H	40	76	1354	F-I	33	85
F78-1459	G	2072	B-G	23	99	1450	D-I	29	91
F78-1562	T	2279	A-E	6	109	1345	F-I	35	85
F78-1571	T	1932	C-H	31	93	1731	A-F	9	109

Table 1—continued

Geno-type	Se-lec-ted at	Gainesville yield				Tancasneque yield			
		Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
F78-1572	T	1673	G-H	39	80	1326	F-I	37	84
F78-1573	T	2216	A-F	11	106	1355	F-I	32	85
F78-1577	T	1867	D-H	35	90	1285	G-I	38	81
F78-1622	G	1804	F-H	38	86	1414	E-I	30	89
F78-1639	G	1960	B-H	29	94	1532	B-I	25	97
F78-1642	G	1879	D-H	34	90	1257	H-I	39	79
Test mean		2086			100	1587			100

G and T refer to Gainesville and Tancasneque respectively.
+ means with the same letter are not significantly different at the .05 level.

Table 2. Agronomic characteristics of 40 soybean genotypes grown during 1979 at two locations. (Test 1979, A-1).

Genotype	Days from planting to: Begin flowering G	Begin flowering T	Maturity G	Maturity T	Plant height cm G	Plant height cm T	Seed weight g/100 G	Seed weight g/100 T
Jupiter	49	48	114	102	93	84	15.50	13.0
UFV-1	43	42	108	100	72	51	11.80	14.0
F78-1005	49	49	115	100	81	65	18.10	13.0
F78-1015	47	46	118	102	90	77	17.92	14.0
F78-1045	43	42	114	102	95	59	18.83	14.0
F78-1077	42	42	111	98	86	68	18.53	16.0
F78-1089	46	43	114	102	83	84	13.96	14.0
F78-1095	45	43	117	104	92	54	19.16	13.0
F78-1096	42	42	113	103	87	52	19.12	16.0
F78-1128	47	43	118	104	92	61	20.33	14.0
F78-1129	40	42	106	100	88	54	16.95	14.0
F78-1130	42	43	114	104	82	72	21.58	19.0
F78-1133	41	43	113	103	87	95	18.58	14.0
F78-1134	45	46	118	103	84	64	18.83	14.0
F78-1141	53	50	116	104	95	69	13.38	12.0
F78-1160	49	46	114	100	98	91	14.20	11.0
F78-1162	45	43	116	103	91	60	16.41	14.0
F78-1169	45	42	108	100	107	89	16.84	15.0
F78-1186	42	42	108	100	93	62	15.48	15.0
F78-1192	45	42	114	102	87	74	17.69	15.0
F78-1195	45	42	116	102	94	83	16.06	15.0
F78-1196	44	43	112	98	85	58	19.22	15.0
F78-1202	49	48	114	100	97	72	15.34	11.0
F78-1206	49	50	113	102	97	104	14.81	11.0
F78-1411	50	49	124	108	117	78	13.52	11.0
F78-1424	45	42	118	102	106	80	11.81	12.0
F78-1428	53	52	114	109	103	99	14.01	11.0
F78-1429	49	49	114	106	98	87	15.80	14.0
F78-1430	45	44	123	109	98	72	14.42	12.0
F78-1448	38	38	100	100	64	71	16.66	16.0
F78-1457	33	35	92	93	49	68	14.59	15.0
F78-1459	37	42	98	93	69	62	16.58	16.0
F78-1562	38	36	106	93	67	53	16.22	18.0
F78-1571	38	36	108	98	63	59	14.59	16.0

Table 2—continued

Genotype	Days from planting to: Begin flowering G	Begin flowering T	Maturity G	Maturity T	Plant height cm G	Plant height cm T	Seed weight g/100 G	Seed weight g/100 T
F78-1572	38	36	103	93	75	57	13.28	16.0
F78-1573	40	38	108	94	78	54	15.39	16.0
F78-1577	38	36	108	92	73	60	15.04	17.0
F78-1622	37	36	103	92	69	53	16.32	19.0
F78-1639	37	36	105	90	67	68	14.86	16.0
F78-1642	38	35	103	92	81	40	14.76	16.0
Mean	43.52	42.55	111.27	100.05	85.82	69.07	16.16	14.42

G and T refer to Gainesville and Tancasneque respectively.

Table 3. Mean yield of 24 soybean genotypes grown during 1980 at four locations in kg/ha, rank, and as percent of overall test mean. (Test 1980, A-3). Duncan's test at .05 level.

	Gainesville yield				Tancasneque yield			
Genotype	Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
Jupiter	1681	A-C	13	100	1551	D-E	15	97
UFV-1	1742	A-B	10	103	1631	B-E	9	102
F75-9207	1834	A	3	109	1664	B-D	5	104
F78-1045	1614	A-C	19	96	1616	B-E	10	101
F78-1077	1594	A-D	20	94	1542	D-E	16	97
F78-1089	1657	A-C	17	98	1673	B-D	4	105
F78-1128	1743	A-B	9	103	1928	A-B	2	121
F78-1129	1725	A-B	12	102	1574	C-E	13	99
F78-1130	1870	A	1	111	1662	B-D	6	104
F78-1133	1819	A	5	108	1563	C-E	14	98
F78-1134	1817	A	6	108	2156	A	1	135
F78-1160	1650	A-C	18	98	1360	D-E	23	85
F78-1162	1834	A	4	109	1662	B-D	7	104
F78-1169	1839	A	2	109	1527	D-E	17	96
F78-1192	1680	A-C	14	100	1612	B-E	11	101
F78-1195	1788	A-B	8	106	1606	B-E	12	101
F78-1206	1728	A-B	11	102	1637	B-E	8	103
F78-1411	1658	A-C	16	98	1906	A-C	3	120
F78-1428	1579	A-D	21	94	1417	D-E	20	89
F78-1448	1658	A-C	15	98	1376	D-E	22	86
F78-1457	1298	D	24	77	1401	D-E	21	88
F78-1562	1477	B-D	22	88	1423	D-E	19	89
F78-1571	1802	A-B	7	107	1478	D-E	18	93
F78-1639	1383	C-D	23	82	1287	E	24	81
	1686			100	1594			100

+ means with the same letter are not significantly different at the .05 level.

Table 3—extended

Tapachula yield				Boliche yield			
Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
3341	A	5	110	742	E-F	23	56
3251	A	7	107	1377	A-D	9	104
2743	A	20	90	1324	A-D	13	100
3604	A	2	118	1427	A-D	7	108
2884	A	17	95	1134	D-F	21	86
3202	A	11	105	1140	D-F	20	86
3695	A	1	121	1366	A-D	10	103
2784	A	19	91	1296	A-D	15	98
3456	A	3	113	1852	A	1	140
3120	A	12	102	1199	D-E	18	91
3406	A	4	112	1542	A-D	5	116
3119	A	13	102	1381	A-D	8	104
3234	A	9	106	1546	A-D	4	117
3246	A	8	107	1520	A-D	6	115
3041	A	15	100	1269	B-E	16	96
3271	A	6	107	1803	A-B	2	136
3034	A	16	100	1300	A-D	14	98
2102	A	24	69	1784	A-C	3	135
2627	A	21	86	1230	C-E	17	93
2851	A	18	94	1361	A-D	11	103
2199	A	23	72	659	F	24	50
3114	A	14	102	1353	A-D	12	102
2558	A	22	84	1150	D-F	19	87
3230	A	10	106	1017	D-F	22	77
3046			100	1324			100

Table 4. Agronomic characteristics of 24 soybean genotypes grown during 1980 at four locations. (Test 1980, A-3).

Genotype	Days from planting to: Begin flowering				Maturity			
	G	T	C	B	G	T	C	B
Jupiter	53	50	49	50	118	108	110	125
UFV-1	48	41	38	37	117	102	116	112
F75-9207	49	43	37	32	122	105	116	105
F78-1045	46	41	38	33	118	106	113	114
F78-1077	46	41	37	38	114	99	104	112
F78-1089	49	46	41	41	118	103	110	123
F78-1128	52	46	42	41	122	110	116	130
F78-1129	44	41	35	34	114	105	116	112
F78-1130	46	42	40	39	118	105	107	114
F78-1133	48	42	41	34	120	105	116	117
F78-1134	49	45	40	41	122	107	120	128
F78-1160	52	48	48	43	124	105	123	132
F78-1162	49	43	43	40	124	107	118	128
F78-1169	48	42	41	40	114	101	104	112
F78-1192	49	43	42	39	119	108	116	128
F78-1195	49	42	43	35	126	106	114	112
F78-1206	53	48	48	49	120	107	116	119
F78-1411	56	50	47	43	132	124	133	145
F78-1428	60	55	50	50	128	111	113	126
F78-1448	43	39	34	37	105	97	101	112
F78-1457	41	34	31	32	100	97	101	107
F78-1562	43	37	32	32	110	97	102	105
F78-1571	44	38	37	32	112	97	103	112
F78-1639	43	36	33	32	110	97	102	105
Test mean	48	43	40	39	118	104	112	118

G, T, C and B refer to Gainesville, Tancasneque, Tapachula and Boliche respectively.

Table 4—extended

Plant height cm				Seed weight g/100			Node number		Canopy width (cm)
G	T	C	B	G	T	B	G	T	G
76	64	83	54	13.23	14	24.2	12	11	45
47	35	66	32	10.56	13	20.5	11	8	50
67	56	77	25	12.88	12	19.2	17	13	60
80	68	91	45	15.80	14	23.8	12	10	50
55	46	79	39	14.82	15	18.8	11	10	55
60	55	78	49	11.14	13	18.6	11	10	55
70	72	89	51	16.93	15	25.4	12	11	55
77	65	80	37	15.23	13	21.7	11	10	50
62	58	89	50	15.22	16	23.1	11	11	55
85	76	92	59	16.46	15	22.7	13	11	50
80	67	97	48	16.99	16	23.7	13	12	60
85	72	98	59	13.71	13	21.4	15	12	55
70	60	87	47	14.61	15	22.4	12	10	55
60	64	98	70	15.66	15	21.5	12	11	55
75	71	90	51	14.82	15	24.7	13	10	50
80	68	86	42	15.34	14	22.2	13	11	55
77	70	87	61	13.57	14	22.8	13	11	55
112	114	131	82	13.14	15	20.1	21	18	70
82	68	94	62	13.15	15	20.3	17	13	65
60	44	66	40	13.54	17	20.4	12	12	50
42	34	57	28	14.01	15	19.4	12	10	45
55	56	69	30	13.71	15	23.8	12	11	50
57	44	64	26	11.67	13	23.5	11	10	55
50	50	68	26	13.13	13	20.6	13	11	45
69	61	84	46	14.14	14	21.9	13	11	54

Table 5. Mean yield of 40 soybean genotypes grown during 1979 at two locations in kg/ha, rank and as percent of overall test mean. (Test 1979, A-2). Duncan's test at .05 level.

Geno-type	Se-lec-ted at	Gainesville yield				Tancasneque yield			
		Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
Jupiter		1883	C-N	22	97	1579	B-G	23	96
UFV-1		2057	C-L	15	106	1699	A-G	16	103
F78-1219	T	1818	D-N	27	94	1874	A-F	8	113
F78-1220	T	1968	C-M	18	101	1625	B-G	19	98
F78-1221	G	1756	F-N	31	90	2122	A-C	4	128
F78-1236	G	1560	K-N	37	80	1833	A-G	12	111
F78-1237	G	1597	I-N	35	82	1363	D-G	36	83
F78-1240	G	1788	E-N	29	92	1855	A-G	10	112
F78-1241	G	2305	A-E	5	119	1495	C-G	27	90
F78-1243	G	1913	C-N	21	98	1725	A-G	14	104
F78-1244	G	1644	H-N	34	85	1561	B-G	25	94
F78-1246	G	2121	B-H	10	109	1162	G	40	70
F78-1247	G	2120	B-I	11	109	1443	C-G	32	87
F78-1250	T	2651	A	1	136	1854	A-G	11	112
F78-1251	T	1954	C-M	19	101	1997	A-D	5	121
F78-1278	G	1417	N	40	73	1407	D-G	34	85
F78-1294	T	1452	M-N	39	75	1520	C-G	26	92
F78-1310	T	1702	G-N	32	88	1451	C-G	31	88
F78-1314	T	1812	D-N	28	93	1488	C-G	28	90
F78-1316	G	2133	B-H	9	110	1625	B-G	18	98
F78-1319	G	1843	D-N	24	95	1226	E-G	38	74
F78-1331	T	2335	A-D	4	120	2230	A-B	2	135
F78-1347	T	1883	C-N	23	97	1873	A-F	9	113
F78-1350	T	2073	B-K	14	107	1893	A-E	7	115
F78-1351	G	2367	A-C	3	122	1953	A-D	6	118
F78-1373	G	2177	A-G	7	112	1743	A-G	13	106
F78-1377	G	2580	A-B	2	133	2365	A	1	143
F78-1378	T	2262	A-F	6	116	1617	B-G	20	98
F78-1398	T	2103	B-J	12	108	1584	B-G	22	96
F78-1402	G	2012	C-L	17	104	1456	C-G	30	88
F78-1464	T	1839	D-N	25	95	1572	B-G	24	95
F78-1469	T	2027	C-L	16	104	1714	A-G	15	104
F78-1490	T	1662	G-N	33	86	1191	F-G	39	72
F78-1496	T	1763	F-N	30	91	1401	D-G	35	85

Table 5—continued

Geno-type	Se-lec-ted at	Gainesville yield				Tancasneque yield			
		Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
F78-1500	G	1583	J-N	36	81	1604	B-G	21	97
F78-1503	G	2102	B-J	13	108	1477	C-G	29	89
F78-1520	G	1835	D-N	26	94	1323	D-G	37	80
F78-1536	T	1916	C-M	20	99	1640	B-G	17	99
F78-1541	T	2167	A-H	8	112	2127	A-C	3	129
F78-1558	T	1547	L-N	38	80	1441	C-G	33	87
Test mean		1943			100	1652			100

G and T refer to Gainesville and Tancasneque respectively.
+ means with the same letter are not significantly different at the .05 level.

Table 6. Agronomic characteristics of 40 soybean genotypes grown during 1979 at two locations. (Test 1979, A-2).

Genotype	Days from planting to: Begin flowering G	Days from planting to: Begin flowering T	Days from planting to: Maturity G	Days from planting to: Maturity T	Plant height cm G	Plant height cm T	Seed weight g/100 G	Seed weight g/100 T
Jupiter	49	49	114	101	86	67	15.89	14.0
UFV-1	43	42	108	102	66	47	11.82	14.0
F78-1219	40	39	106	100	70	54	11.63	14.0
F78-1220	47	47	111	99	87	54	17.30	15.0
F78-1221	44	41	114	98	95	95	16.58	15.0
F78-1236	47	48	114	107	84	71	15.22	14.0
F78-1237	46	43	106	98	76	62	15.33	14.0
F78-1240	48	48	112	102	88	87	15.12	14.0
F78-1241	42	38	108	100	90	57	15.66	15.0
F78-1243	46	45	108	96	83	77	14.92	14.0
F78-1244	43	42	106	100	66	61	16.97	16.0
F78-1246	47	46	106	99	87	44	15.02	14.0
F78-1247	47	46	108	100	90	70	17.49	14.0
F78-1250	44	45	114	104	112	101	16.79	14.0
F78-1251	49	50	115	100	90	83	16.24	15.0
F78-1278	49	49	112	98	99	60	14.16	13.0
F78-1294	45	46	108	96	63	61	9.23	10.0
F78-1310	45	42	113	96	60	46	8.82	8.0
F78-1314	44	42	111	96	59	44	9.14	9.0
F78-1316	43	46	114	101	70	70	10.33	9.0
F78-1319	44	44	106	99	60	51	8.45	9.0
F78-1331	45	43	113	100	109	96	15.46	15.0
F78-1347	45	42	114	102	107	81	13.62	14.0
F78-1350	43	44	113	101	82	71	13.01	13.0
F78-1351	49	48	124	112	87	74	13.62	14.0
F78-1373	47	45	124	103	92	60	13.21	12.0
F78-1377	43	42	114	102	87	79	14.59	14.0
F78-1378	45	46	124	111	91	58	13.51	12.0
F78-1398	50	49	124	113	85	62	11.53	12.0
F78-1402	51	44	124	111	82	65	12.43	12.0
F78-1464	42	42	108	98	77	62	12.75	12.0
F78-1469	43	45	114	112	87	81	14.93	14.0
F78-1490	48	52	111	111	89	76	16.68	16.0
F78-1496	38	41	103	96	70	46	14.22	15.0

Table 6—continued

Genotype	Days from planting to: Begin flowering G	Begin flowering T	Maturity G	Maturity T	Plant height cm G	Plant height cm T	Seed weight g/100 G	Seed weight g/100 T
F78-1500	43	42	114	100	100	76	16.99	14.0
F78-1503	38	37	108	100	72	51	14.15	14.0
F78-1520	38	37	103	92	67	61	13.96	14.0
F78-1536	47	45	114	106	115	83	14.97	14.0
F78-1541	39	42	112	102	83	78	16.30	16.0
F78-1558	37	36	103	101	49	45	15.91	17.0
Mean	44.57	44.00	111.95	101.62	82.80	66.67	14.09	13.45

G and T refer to Gainesville and Tancasneque respectively.

Table 7. Mean yield of 24 soybean genotypes grown during 1980 at four locations in kg/ha, rank and as percent of overall test mean. (Test 1980, A-4). Duncan's test at .05 level.

	Gainesville yield				Tancasneque yield			
Genotype	Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
Jupiter	1685	A	21	91	1839	B-E	10	106
UFV-1	2061	A	3	112	1805	B-E	11	104
F75-9207	2051	A	4	111	1883	A-D	5	108
F78-1219	1815	A	13	98	1645	C-F	16	94
F78-1220	1921	A	7	104	2135	A-B	2	123
F78-1221	1657	A	22	90	1676	B-F	15	96
F78-1236	1699	A	20	92	1870	A-E	7	107
F78-1240	1711	A	19	93	1786	B-E	12	103
F78-1241	1625	A	24	88	1763	B-E	13	101
F78-1243	1753	A	16	95	1570	C-F	19	90
F78-1246	1853	A	11	100	1465	D-F	22	84
F78-1247	1803	A	14	98	1268	F	24	73
F78-1250	1995	A	5	108	1881	A-D	6	108
F78-1251	1993	A	6	108	1866	A-E	8	107
F78-1316	1743	A	17	95	1475	D-F	21	85
F78-1331	2061	A	2	112	1887	A-D	4	108
F78-1347	1713	A	18	93	1477	D-F	20	85
F78-1350	1913	A	9	104	1389	E-F	23	80
F78-1351	1788	A	15	97	1604	C-F	17	92
F78-1373	2125	A	1	115	1861	A-E	9	107
F78-1377	1893	A	10	103	2321	A	1	133
F78-1378	1837	A	12	100	1967	A-C	3	113
F78-1469	1634	A	23	89	1727	B-F	14	99
F78-1541	1915	A	8	104	1600	C-F	18	92
	1844				1740			

+ means with the same letter are not significantly different at the .05 level.

Table 7—extended

Tapachula yield				Boliche yield			
Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
3320	A-D	6	106	1224	A	22	80
3535	A-B	2	113	1619	A	9	105
2994	C-G	18	95	1291	A	20	84
3293	A-E	9	105	1337	A	17	87
3305	A-D	7	105	1044	A	24	68
2705	F-G	23	86	1971	A	3	128
3596	A	1	115	1704	A	7	111
3129	A-F	13	100	1393	A	15	91
2805	E-G	22	89	1424	A	14	93
2998	C-G	17	95	2234	A	1	146
3296	A-E	8	105	1320	A	18	86
3190	A-F	12	102	1759	A	5	115
3444	A-C	3	110	2196	A	2	143
3022	C-G	16	96	1228	A	21	80
2564	G	24	82	1049	A	23	68
3347	A-D	5	107	1641	A	8	107
2941	D-G	20	94	1726	A	6	112
3201	A-E	11	102	1566	A	10	102
2982	C-G	19	95	1526	A	11	99
3107	A-F	14	99	1388	A	16	90
3206	A-E	10	102	1462	A	13	95
3408	A-D	4	109	1911	A	4	124
2920	D-G	21	93	1308	A	19	85
3055	B-F	15	97	1512	A	12	99
3140				1535			

Table 8. Agronomic characteristics of 24 soybean genotypes grown during 1980 at four locations. (Test 1980, A-4).

Genotype	Days from planting to: Begin flowering				Maturity			
	G	T	C	B	G	T	C	B
Jupiter	53	50	48	48	118	105	110	130
UFV-1	48	41	38	37	117	105	111	121
F75-9207	49	43	38	32	122	105	117	119
F78-1219	45	41	34	36	116	102	105	121
F78-1220	53	47	44	44	117	103	105	130
F78-1221	49	42	39	37	112	101	105	111
F78-1236	51	48	45	47	120	105	113	128
F78-1240	51	48	46	45	118	103	109	128
F78-1241	45	40	35	35	114	105	105	117
F78-1243	44	47	41	39	114	101	104	110
F78-1246	55	47	42	38	116	101	104	120
F78-1247	50	47	41	42	114	101	105	115
F78-1250	50	43	41	39	122	112	112	119
F78-1251	53	51	49	44	121	105	110	128
F78-1316	50	49	38	32	121	112	115	117
F78-1331	51	46	40	39	121	105	111	117
F78-1347	50	43	41	39	114	105	107	115
F78-1350	49	42	38	39	118	105	108	117
F78-1351	57	50	46	39	129	124	131	135
F78-1373	51	50	44	39	129	124	133	130
F78-1377	49	43	38	42	122	109	104	135
F78-1378	50	47	41	39	130	124	127	135
F78-1469	49	48	46	47	124	124	115	130
F78-1541	44	40	34	32	119	103	104	122
Test mean	50	46	41	40	119	108	111	123

G, T, C, and B refer to Gainesville, Tancasneque, Tapachula and Boliche respectively.

Table 8—extended

Plant height cm				Seed weight g/100			Node number		Canopy width (cm)
G	T	C	B	G	T	B	G	T	G
70	74	84	59	14.31	14	25.3	13	12	50
55	47	64	31	11.11	14	21.0	11	11	55
65	63	73	39	13.45	12	22.3	16	16	60
57	46	67	39	10.63	12	22.8	10	10	50
80	64	79	56	15.64	16	26.1	13	11	60
80	82	109	63	14.36	15	23.1	15	16	60
65	69	78	51	14.50	15	24.7	11	10	50
85	58	92	51	13.21	13	24.9	13	14	65
77	69	103	54	13.07	13	25.1	16	16	60
77	62	78	58	12.37	13	22.0	12	12	55
80	64	76	61	15.11	13	26.1	13	13	55
80	59	82	56	15.53	13	24.5	13	13	60
90	86	121	64	14.93	14	23.9	16	17	60
72	74	79	62	14.80	14	28.5	13	14	50
62	57	65	30	9.35	12	16.2	13	9	60
85	90	116	66	13.92	14	22.6	14	17	70
87	81	114	55	11.27	11	19.1	14	17	60
75	67	85	44	12.42	11	17.8	15	17	60
75	75	76	45	14.52	15	21.2	13	12	70
80	78	74	30	13.61	15	20.8	13	12	65
65	72	86	37	13.84	14	21.4	13	13	60
70	85	80	41	12.76	16	21.0	13	12	65
72	81	86	68	13.19	13	20.4	16	12	75
72	62	76	35	14.28	13	22.2	13	14	60
74	69	85	50	13.42	14	22.6	13	13	

Table 9. Mean yield of 24 soybean genotypes grown during 1978 at two locations in kg/ha, rank, and as percent of overall test mean. (Test 1978, B-1). Duncan's test at .05 level.

Genotype	Gainesville yield				Tancasneque yield			
	Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
Jupiter	1348	B-D	21	87	1457	A-C	3	115
UFV-1	1463	B-D	16	94	1544	A-B	2	122
F76-6719	1765	A-C	4	114	1113	D	21	88
F76-6724	1350	B-D	20	87	1171	C-D	19	92
F76-6728	1590	B-C	10	102	1341	A-D	7	106
F76-6854	1533	B-D	12	99	1210	C-D	16	95
F76-6858	887	D	24	57	1321	A-D	9	104
F76-6938	1422	B-D	19	92	1599	A	1	126
F76-7000	1438	B-D	18	93	1378	A-D	5	109
F76-7087	2301	A	1	148	1043		24	82
F76-7095	1931	A-B	2	124	1215	C-D	15	96
F76-7113	1332	B-D	22	86	1304	A-D	10	103
F76-7145	1497	B-D	14	96	1220	C-D	14	96
F76-7162	1161	C-D	23	75	1283	B-D	11	101
F76-7205	1471	B-D	15	95	1146	C-D	20	90
F76-7215	1792	A-C	3	115	1357	A-D	6	107
F76-7295	1752	A-C	6	113	1329	A-D	8	105
F76-7298	1554	B-C	11	100	1173	C-D	18	93
F76-7323	1648	B-C	7	106	1403	A-D	4	111
F76-7326	1526	B-D	13	98	1085	D	23	86
F76-7333	1641	B-C	8	106	1186	C-D	17	94
F76-7336	1761	A-C	5	113	1100	D	22	87
F76-7351	1640	B-C	9	106	1243	B-D	12	98
F76-7376	1459	B-D	17	94	1221	C-D	13	96
Test mean	1553			100	1268			100

+ means with the same letter are not significantly different at the .05 level.

Table 10. Agronomic characteristics of 24 soybean genotypes grown during 1978 at two locations. (Test 1978, B-1).

Genotype	Days from planting to: Beginning flowering G	Days from planting to: Beginning flowering T	Days from planting to: Maturity G	Days from planting to: Maturity T	Plant height cm G	Plant height cm T
Jupiter	45	41	115	105	63	45
UFV-1	44	35	112	105	46	34
F76-6719	46	41	108	97	51	27
F76-6724	47	41	110	100	58	41
F76-6728	44	41	114	102	61	38
F76-6854	45	40	110	105	45	34
F76-6858	53	48	112	100	44	37
F76-6938	53	49	115	102	68	46
F76-7000	53	44	115	102	69	48
F76-7087	44	38	114	105	74	34
F76-7095	44	38	110	105	71	35
F76-7113	46	41	109	97	47	36
F76-7145	44	40	113	101	55	38
F76-7162	40	35	107	97	39	25
F76-7205	44	41	112	105	42	30
F76-7215	49	41	112	103	60	37
F76-7295	53	49	120	105	65	43
F76-7298	51	48	118	109	58	36
F76-7323	53	47	120	105	64	40
F76-7326	53	47	120	113	62	35
F76-7333	53	44	116	105	54	38
F76-7336	53	44	115	105	63	40
F76-7351	53	48	120	111	53	40
F76-7376	51	48	119	111	65	43
Test mean	48	43	114	104	57	37

G and T refer to Gainesville and Tancasneque respectively.

Table 11. Mean yield of 22 soybean genotypes grown during 1978 at two locations in kg/ha, rank, and as percent of overall test mean. (Test 1978, B-2). Duncan's test at .05 level.

Genotype	Gainesville yield				Tancasneque yield			
	Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
Jupiter	1787	A-C	16	104	1661	A-B	2	128
UFV-1	1542	A-C	17	90	1390	A-D	7	108
D73-9360	1887	A-C	8	110	993	D-E	21	77
F74-2716	1609	A-C	16	94	1326	A-D	11	103
F74-3491	1499	B-C	18	87	1110	B-E	19	86
F75-7093	1914	A-C	7	111	782	E	22	60
F75-9207	2051	A-B	2	119	1549	A-C	4	120
F75-9209	1968	A-C	5	114	1329	A-D	10	103
F76-6554	698	D	22	41	1134	B-E	17	88
F76-6570	1432	B-C	19	83	1112	B-E	18	86
F76-9835	1356	C	21	79	1695	A	1	131
F76-9967	1692	A-C	15	98	1304	A-E	12	101
F76-0002	1694	A-C	14	98	1150	A-E	16	89
F76-0007	2183	A	1	127	1154	A-E	15	89
F76-6875	1848	A-C	9	107	1330	A-D	9	103
F76-6883	1769	A-C	13	103	1604	A-B	3	124
F76-6884	2024	A-C	3	118	1300	A-E	13	101
F76-6918	1969	A-C	4	114	1178	A-E	14	91
F76-6928	1363	C	20	79	1495	A-D	5	116
F76-7233	1835	A-C	10	107	1435	A-D	6	111
F76-7236	1923	A-C	6	112	1366	A-D	8	106
F76-7452	1796	A-C	11	104	1045	C-E	20	81
Test mean	1720			100	1293			100

+ means with the same letter are not significantly different at the .05 level.

Table 12. Agronomic characteristics of 22 soybean genotypes grown during 1978 at two locations. (Test 1978, B-2).

Genotype	Days from planting to: Begin flowering G	Begin flowering T	Maturity G	Maturity T	Plant height cm G	Plant height cm T
Jupiter	47	43	115	105	68	54
UFV-1	46	35	112	105	57	36
D73-9360	41	37	112	103	47	28
F74-2716	39	34	111	105	45	28
F74-3491	40	34	108	97	45	30
F75-7093	37	34	101	97	62	30
F75-9207	50	41	116	105	75	40
F75-9209	48	39	112	105	77	40
F76-6554	55	48	112	109	60	20
F76-6570	53	48	113	109	64	27
F76-9835	43	36	107	105	50	40
F76-9967	51	41	118	105	63	41
F76-0002	47	41	106	97	64	37
F76-0007	46	41	107	97	55	33
F76-6875	53	49	119	109	68	47
F76-6883	46	39	117	109	61	41
F76-6884	50	48	120	105	70	43
F76-6918	47	41	117	105	73	40
F76-6928	54	49	115	101	82	59
F76-7233	51	47	117	107	67	36
F76-7236	52	47	117	105	69	34
F76-7452	37	34	104	97	53	26
Test mean	47	41	112	104	62	37

G and T refer to Gainesville and Tancasneque respectively.

Table 13. Mean yield of 24 soybean genotypes grown during 1979 at three locations in kg/ha, rank and as percent of overall test mean. (Test 1979, B-3). Duncan's test at .05 level.

Genotype	Gainesville yield: Yield in kg/ha	+	Rank no.	Yield in %	Tancasneque yield: Yield in kg/ha	+	Rank no.	Yield in %
Jupiter	1602	A	15	99	1857	A-C	4	121
UFV-1	1775	A	6	110	1865	A-B	3	121
F75-9207	1634	A	2	101	1437	D-H	14	93
F75-9209	1784	A	11	111	1273	F-H	21	83
F75-7093	1855	A	5	115	1251	G-H	23	81
F76-0007	1085	A	24	67	1388	D-H	17	90
F76-6719	1622	A	12	101	1576	B-H	11	102
F76-6728	1455	A	21	90	1355	E-H	18	88
F76-6883	1260	A	23	78	1411	D-H	16	92
F76-6884	1770	A	7	110	1889	A-B	2	123
F76-6918	1702	A	9	106	1446	D-H	13	94
F76-6928	1542	A	17	96	1583	B-G	10	103
F76-6938	1370	A	22	85	1758	B-D	6	114
F76-7000	1675	A	10	104	1649	B-F	8	107
F76-7087	1723	A	8	107	1288	F-H	20	84
F76-7095	1931	A	1	120	1488	C-H	12	97
F76-7113	1616	A	13	100	1426	D-H	15	93
F76-7215	1463	A	20	91	1198	H	24	78
F76-7233	1551	A	16	96	2164	A	1	141
F76-7236	1839	A	3	114	1252	G-H	22	81
F76-7295	1490	A	19	92	1592	B-G	9	104
F76-7323	1607	A	14	100	1315	E-H	19	86
F76-7351	1540	A	18	95	1672	B-E	7	109
F76-9835	1811	A	4	112	1769	B-D	5	115
	1613			100	1538			100

+ means with the same letter are not significantly different at the .05 level.

Table 13—extended

Boliche yield			
Yield in kg/ha	+	Rank no.	Yield in %
2598	B-D	7	115
2582	B-D	8	114
1290	I	24	57
1378	H-I	23	61
2037	D-G	16	90
1977	E-G	17	88
2389	B-F	11	106
1830	F-H	21	81
1846	F-H	19	82
2790	A-B	2	124
2519	B-E	10	112
2693	A-C	6	119
2699	A-C	5	119
2261	B-F	14	100
1875	F-H	18	83
2309	B-F	12	102
1839	F-H	20	81
1585	G-I	22	70
3170	A	1	140
2704	A-C	4	120
2278	B-F	13	101
2784	A-B	3	123
2580	B-D	9	114
2199	C-F	15	97
2259			100

Table 14. Agronomic characteristics of 24 soybean genotypes grown during 1979 at three locations. (Test 1979, B-3).

Genotype	Days from planting to: Begin flowering			Days from planting to: Maturity			Plant height cm			Seed weight g/100		
	G	T	B	G	T	B	G	T	B	G	T	B
Jupiter	49	49	36	114	104	118	79	71	68	14.27	16	24.2
UFV-1	43	42	37	108	104	113	53	47	37	11.03	14	22.2
F75-7093	36	35	29	100	99	110	59	51	41	16.16	14	25.8
F75-9207	44	41	34	112	106	113	60	49	29	12.20	14	23.4
F75-9209	42	38	34	111	104	113	68	47	39	13.25	15	23.3
F76-0007	43	42	37	106	100	113	40	47	39	11.93	13	19.6
F76-6719	42	42	37	103	99	110	55	48	44	15.24	16	21.7
F76-6728	40	38	34	106	99	104	53	52	35	12.52	12	17.8
F76-6883	43	42	37	114	104	118	56	45	52	13.12	12	21.3
F76-6884	45	44	41	117	103	123	79	56	58	15.15	15	23.4
F76-6918	45	43	38	114	104	118	72	54	61	15.29	14	26.1
F76-6928	46	49	45	114	103	118	88	73	70	15.22	17	21.3
F76-6938	47	48	46	114	103	115	69	68	66	14.23	16	23.9
F76-7000	47	49	46	112	102	118	67	63	64	14.21	14	24.9
F76-7087	38	36	30	106	99	113	55	43	43	13.83	16	23.3
F76-7095	40	35	34	108	97	110	58	50	43	14.25	15	23.9
F76-7113	44	42	36	103	99	115	52	45	38	14.94	14	21.5
F76-7215	44	40	34	108	105	113	53	41	38	12.58	14	21.8
F76-7233	46	46	43	117	111	124	64	54	57	15.53	16	22.1
F76-7236	46	46	41	115	105	118	67	52	52	15.77	12	20.5
F76-7295	49	48	45	119	108	121	69	67	63	14.47	14	22.9
F76-7323	49	47	45	114	104	115	71	56	71	13.63	13	22.4
F76-7351	50	48	45	114	108	121	66	64	63	14.54	16	21.2
F76-9835	39	38	36	106	101	107	58	50	42	15.77	18	21.9
Mean	44	43	38	111	103	115	63	54	51	14.13	15	22.5

G, T and B refer to Gainesville, Tancasneque and Boliche respectively.

Table 15. Mean yield of 24 soybean genotypes grown during 1980 at four locations in kg/ha, rank, and as percent of overall test mean. (Test 1980, B-4). Duncan's test at .05 level.

Genotype	Gainesville yield				Tancasneque yield			
	Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
Jupiter	1859	A	17	96	2274	A-D	11	104
UFV-1	1973	A	10	102	2460	A-B	2	113
F75-9207	1902	A	14	98	1992	B-F	19	91
F75-9209	1830	A	18	94	1875	C-F	21	86
F75-7093	2042	A	7	105	1632	F	24	75
F76-0007	2105	A	5	108	2405	A-B	5	110
F76-6719	1727	A	23	89	2310	A-C	10	106
F76-6728	1932	A	12	99	2056	B-F	18	94
F76-6883	1867	A	16	96	2435	A-B	4	112
F76-6884	1975	A	9	102	2138	B-E	13	98
F76-6918	1783	A	21	92	2185	B-E	12	100
F76-6928	1936	A	11	100	1982	B-F	20	91
F76-6938	2039	A	8	105	2383	A-B	7	109
F76-7000	1781	A	22	92	2762	A	1	127
F76-7987	2140	A	3	110	2135	B-E	14	98
F76-7095	1905	A	13	98	2116	B-F	16	97
F76-7113	1825	A	19	94	2446	A-B	3	112
F76-7215	2221	A	2	114	2122	B-F	15	97
F76-7233	1798	A	20	93	2396	A-B	6	110
F76-7236	2229	A	1	115	2078	B-F	17	95
F76-7295	2055	A	6	106	1784	D-F	22	82
F76-7323	1882	A	15	97	2341	A-C	8	107
F76-7351	1690	A	24	87	1738	E-F	23	80
F76-9835	2136	A	4	110	2332	A-C	9	107
	1943			100	2182			100

+ means with the same letter are not significantly different at the .05 level.

Table 15—extended

Tapachula yield				Boliche yield			
Yield in kg/ha	+	Rank no.	Yield in %	Yield in kg/ha	+	Rank no.	Yield in %
3409	A	6	109	1265	C-F	18	86
3541	A	1	113	1454	A-E	12	99
3051	A-C	15	97	1714	A-E	6	116
2836	A-C	21	91	1365	B-F	15	93
3256	A-C	11	104	801	F	24	54
3353	A-B	8	107	1327	C-F	16	90
2585	B-C	22	83	1782	A-E	5	121
2857	A-C	20	91	1278	C-F	17	87
3357	A-B	7	107	1495	A-E	10	102
3531	A	2	113	1645	A-E	7	112
3062	A-C	14	98	1229	C-F	21	83
3228	A-C	12	103	1261	C-F	19	86
3318	A-C	9	106	1370	B-F	14	93
2968	A-C	17	95	1188	D-F	22	81
2985	A-C	16	95	1131	E-F	23	77
2557	B-C	23	82	1233	C-F	20	84
2541	C	24	81	1877	A-C	3	128
2963	A-C	18	95	1493	A-E	11	101
3497	A	4	112	1373	B-F	13	93
3523	A	3	112	1601	A-E	8	109
3445	A	5	110	1833	A-D	4	125
3293	A-C	10	105	1593	A-E	9	108
2879	A-C	19	92	2036	A	1	138
3149	A-C	13	101	1986	A-B	2	135
3133			100	1472			100

Table 16. Agronomic characteristics of 24 soybean genotypes grown during 1980 at four locations. (Test 1980, B-4).

Genotype	Days from planting to: Begin flowering				Maturity			
	G	T	C	B	G	T	C	B
Jupiter	53	53	48	48	118	118	110	122
UFV-1	49	43	38	36	117	115	112	113
F75-9207	49	45	37	31	122	118	117	104
F75-9209	50	43	36	31	122	118	117	104
F75-7093	42	40	31	31	107	106	98	104
F76-0007	47	42	39	34	114	112	104	104
F76-6719	49	43	39	33	110	112	103	104
F76-6728	46	42	34	31	121	115	110	104
F76-6883	49	45	41	34	124	118	112	124
F76-6884	51	47	44	41	122	118	115	129
F76-6918	48	46	42	33	121	118	112	134
F76-6928	55	52	48	47	118	112	107	118
F76-6938	53	52	48	48	118	118	105	122
F76-7000	49	52	48	48	120	118	109	124
F76-7087	46	41	33	31	114	112	104	104
F76-7095	46	42	33	31	118	115	102	104
F76-7113	49	44	40	34	109	112	103	104
F76-7215	50	45	36	31	121	118	114	104
F76-7233	53	48	43	43	126	118	112	129
F76-7236	51	47	42	40	122	115	115	129
F76-7295	54	52	48	47	121	118	112	124
F76-7323	56	51	47	47	120	118	106	127
F76-7351	56	51	47	43	126	118	117	122
F76-9835	45	41	34	31	113	118	105	106
Mean	50	46	41	38	118	116	109	115

G, T, C and B refer to Gainesville, Tancasneque, Tapachula and Boliche respectively.

Table 16—extended

Plant height cm				Seed weight g/100			Node number		
G	T	C	B	G	T	B	G	T	C
74	83	81	62	13.95	17	24.6	12	13	13
55	70	60	28	10.71	15	20.0	11	12	12
80	70	64	31	12.24	14	20.0	17	16	14
84	75	71	29	12.52	16	20.5	16	16	13
65	64	56	25	16.49	17	23.6	12	8	12
57	70	61	27	11.56	14	16.4	12	13	13
57	73	59	34	13.87	16	21.4	14	14	13
80	81	72	26	12.29	13	17.2	16	17	14
70	76	76	45	13.13	15	22.2	13	14	13
77	85	74	61	15.01	18	21.9	13	12	12
90	96	93	52	14.68	16	23.9	14	17	16
97	86	91	62	15.58	16	22.1	14	14	14
77	81	72	62	14.54	16	25.8	13	13	13
75	84	79	51	13.64	16	26.3	12	13	13
72	71	65	25	13.70	16	20.3	15	16	13
87	74	65	29	13.88	16	20.4	15	16	13
60	75	65	37	13.98	17	21.3	13	14	12
84	77	73	25	12.44	14	19.1	17	17	14
72	83	72	33	14.36	14	22.4	15	17	15
77	87	77	46	14.66	14	22.2	15	15	14
77	82	79	57	15.26	16	22.9	16	18	16
77	79	85	51	14.33	16	21.5	13	13	13
75	96	86	57	14.52	14	21.3	16	20	20
64	73	73	32	14.23	17	22.1	11	12	12
74	79	73	41	14.00	15	21.6	14	15	14

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Kuell Hinson, Chairman
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